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A SAILING DORY.

CARL H. CLARK.

This dory is of the usual type used for sailing. The dimensions 18 ft. long by 5 ft. wide, make a boat which, while not very heavy has still enough stability to carry sail well and be safe.

The method of building is very nearly the same as that followed in building the power dory already described, and the directions there contained will be found of much use in building this boat.

The outlines of the moulds are to be taken from the cuts, which are to the scale shown below the outlines of the moulds. The bottom is of oak 1¼″ thick, made up of several widths, if necessary. The necessary dimensions for the bottom are given, so that the outline can easily be drawn. The joints in the bottom should be close on the inside an d open about ⅛″ outside for calking; the several pieces are fastened together with cleats 1½″ square, taking care not to place any where the moulds or bent frames are to go later.

The stem is 2″ thick, and if a natural crook cannot be obtained, should have the grain run diagonally, so as to have as little cross grain as possible; in this case, as before, a false stem is put on later; the inner stem being the only one put into place at present. It is fastened to the forward end of the bottom with galvanized boat nails or rivets, care being taken to have it point straight fore and aft, and at the proper slant.

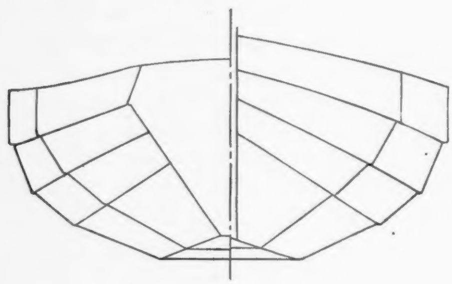
The stern board is laid out from the outline given. In transferring lengths from the drawing the distance to be measured can be taken either with dividers or marked upon the edge of a card and laid on the scale of feet and inches, and the length read off. This length is then laid off full size with a rule; by taking a series of points any outline of moulds, stern, sternboard, etc., can be laid out. The sternboard is of 1″ oak and is held in place by the stern knee, which is cut from 1½″ stock with the grain running the long way. It is fastened with galvanized boat nails or small rivets. Considerable care should be taken to adjust the angles of the stern and the sternboard, as they have great effect upon the final shape of the boat. The sternboard also should have cleats nailed across the inside.

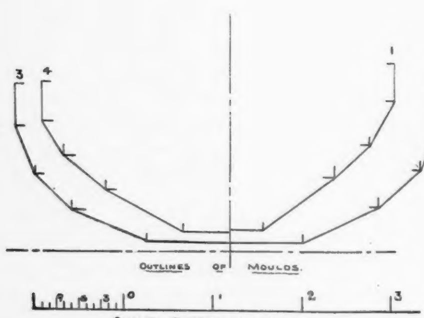
The bottom is next set up on blocks or horses at the proper height for easy working—the centre block should be 3″ lower than the end ones, and the bottom sprung down that amount and held by shores from above.

The moulded frames are next gotten out of natural crook pieces, if possible, to the shape shown. These shapes can be obtained by measuring, using the scale provided. They are of 1″ stock 3″ wide, and extend to the centre line. There are two similar pieces for each frame and they are fastened together by a floor piece nailed on the back of the two parts, and a piece is also nailed across the tops. When the frames are completed they are fastened in place on the bottom, the under side being bevelled somewhat to allow them to set upright on the slightly sloping bottom. They are fastened from below with brass screws. A ribband should also be run around the tops to keep them in line. The edges of the moulds where the plank is to rest are to be bevelled off slightly to allow the plank to rest fairly upon them.

The plank is ⅝″ thick, of either pine, cedar or

cypress—cedar is rather to be preferred, but either of the others will serve. It should be obtained in boards as wide as possible, as there is considerable "spiling" or bend in the plank. The garboard, or lowest streak, is put on first, about as before described; the edge of the bottom bevelled to the varying angle of the lower flat of the moulds. The flat up to the first knuckle should be divided up into two planks, making the lower one very narrow amidships and carrying the ends as wide as possible; this takes out a large amount of the "spiling" and makes the second plank much narrower and easier to fit. The lower planks will need to be in two lenghts with well-fitted joints. The operations of fitting the planks are about the same as in the power dory—the lap at the edges being 1¼″.





SCALE OF FEET AND INCHES.

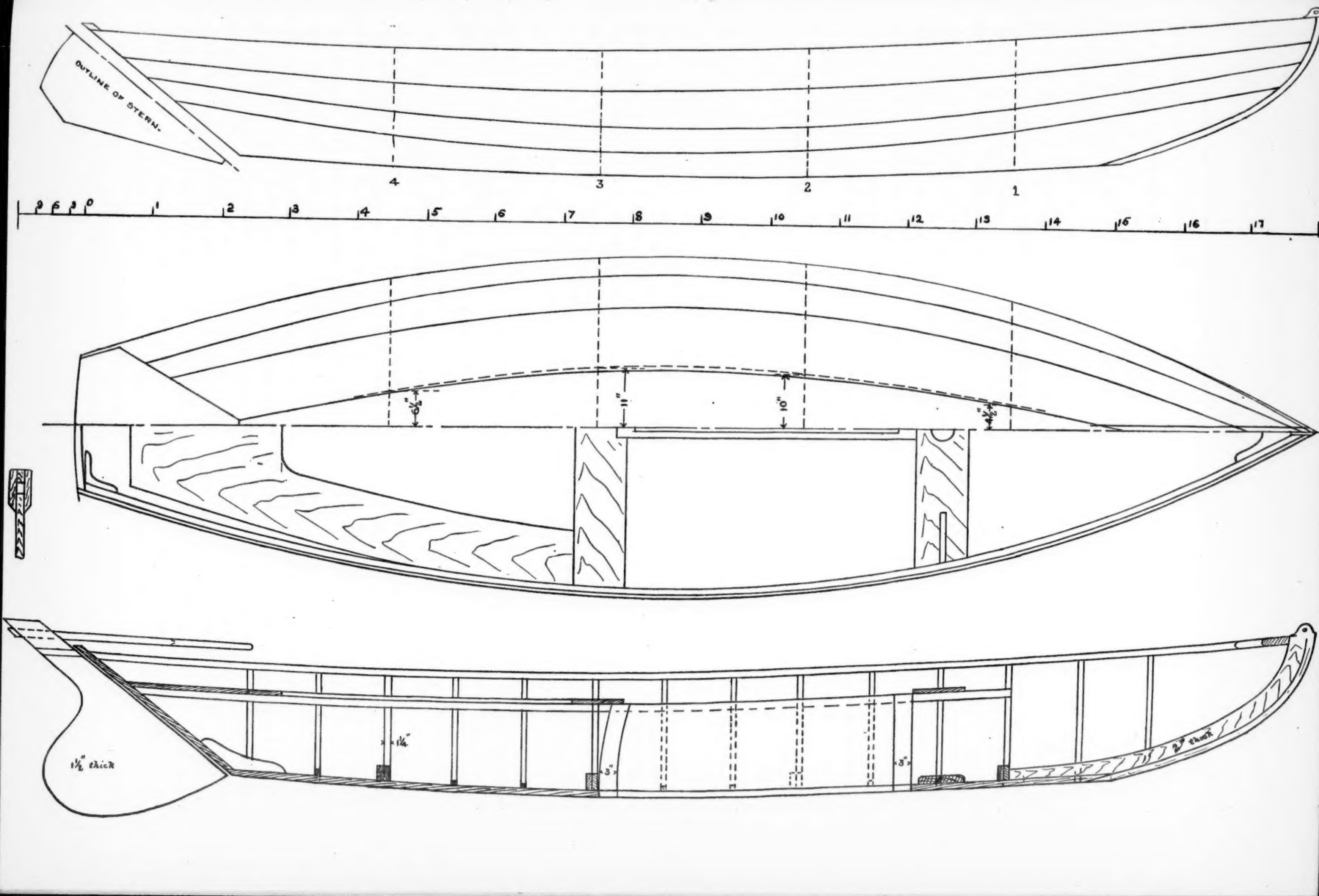
The planks above should be put on in one piece if possible, but in any case, joints in adjacent planks should be well apart. The top streak should be carried ¾″ above the tops of the moulds to admit the gunwale, and the lower edge of the top streak should be beaded. The planks at the stern are cut square across, even with the stem and the false stem fastened on the outside.

The gunwale is 3″x¾″ and is bent around inside the top streak and on the top of the moulds. It is tapered at the ends to about 2″ to make it bend in more easily, and is fastened through the top streak with boat nails, and into the tops of the moulds with long nails. At the bow a breast hook is worked between them, and at the stern a knee is fastened to the sternboard.

Between each two moulds two binders, or light frames about 1″x⅝″ are bent in, extending well on to the bottom. They are first well steamed and then forced well into the corners, to follow the planks as far as possible. They are fastened with nails clinched on the inside and by nails driven into the bottom.

The centre board slot is cut in the position shown on the plans, 1¼″ wide and exactly in the centre of the boat. It should be noted that the uprights at the ends extend down through the bottom, and allowance must be made for them in cutting the slots. The uprights are 3″x1½″ fitted to the ends of the slot. The centreboard box is then built upon them. The joint between the box and the bottom must be carefully made to be tight. The lower board of the box should be of oak 1¼″ thick, fastened to the bottom with heavy screws driven from below, with a layer of lead and a thread of cotton in the joint. The upper boards of the box can be of pine or other stock and should extend to the height of the seats. The top of the box is covered with a board lengthwise. The centreboard is of 1¼″ stock, the lower board being oak. It is of proper size to give an inch or so clearance all around and is through bolted with ⅜″ iron rods. It is set into place and a ⅝″ iron bolt put through for a pivot. At the after top end an eye is screwed in to take the rope to haul up and down, which rope passes out through a hole in the board covering the top of the box. If desired, a rod, such as is sold for the purpose, may be fitted to control the centreboard.

The wale which supports the seats is about 2″ wide by ¾″ thick, and is bent around inside of and fastened to the moulds about 6″ down from the top of the gunwale. The seats rest upon it and are placed as shown. They are of ¾″ stock and rest upon the wale just put in. The forward seat must be of 1″ oak extra strongly fastened, as it supports the mast. It should have knees at the



OUTLINE OF STERN.
4
3
2
1
9 6 3 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
6½"
11"
10"
4½"
1¼"
1½" thick
3"
3"

ends, fastened to the gunwales. A hole 3″ in diameter for the mast is cut in the forward seat. It is to be noted that the cross seats are located at the ends of the centreboard box and fastened to it; which supports both the box and the seats. Directly under the hole in the forward seat a block $1\frac{1}{2}''$ thick is fastened, with a mortise 3″ long and $1\frac{1}{2}''$ wide, to take a corresponding tenon cut in the foot of the mast.

The rudder is of oak $1\frac{1}{2}''$ thick, shaped as shown. To allow the insertion of the tiller the top is cut off and separated from the rest by about 2″ and a block fastened on each side with screws to form the socket. The tiller fits the socket in the rudder head and extends well inboard over the stern seat. To fasten the rudder in place the ordinary rudder hangs, sold by dealers in yacht supplies, are to be used, as the rudder is unshipped when not in use.

The top of the stern board is rounded off, and the top of the stem finished off to a curve similar to that shown. To the top of the stem an eye bolt must be made fast to take the stay for the jib, and a pair of chain plates are to be fastened on the sides about 8″ back from the mast to take the side stays.

It is very desirable to fit the boat with one or two pairs of rowlocks, as there are many times when oars are useful. To support the rowlocks a flat piece of oak about 2″ wide by $\frac{5}{8}''$ thick can be fastened around on the top of each gunwale, and this may be varnished if desired. Gratings are made for the bottom by nailing thin strips of wood on to cross pieces, and are shaped to fit the bottom between the cross timbers and are easily renewed for cleaning.

The rig in common use on this type of boat is the "leg of mutton" type with a small jib. It is the simplest rig possible; very safe and easily shipped and unshipped.

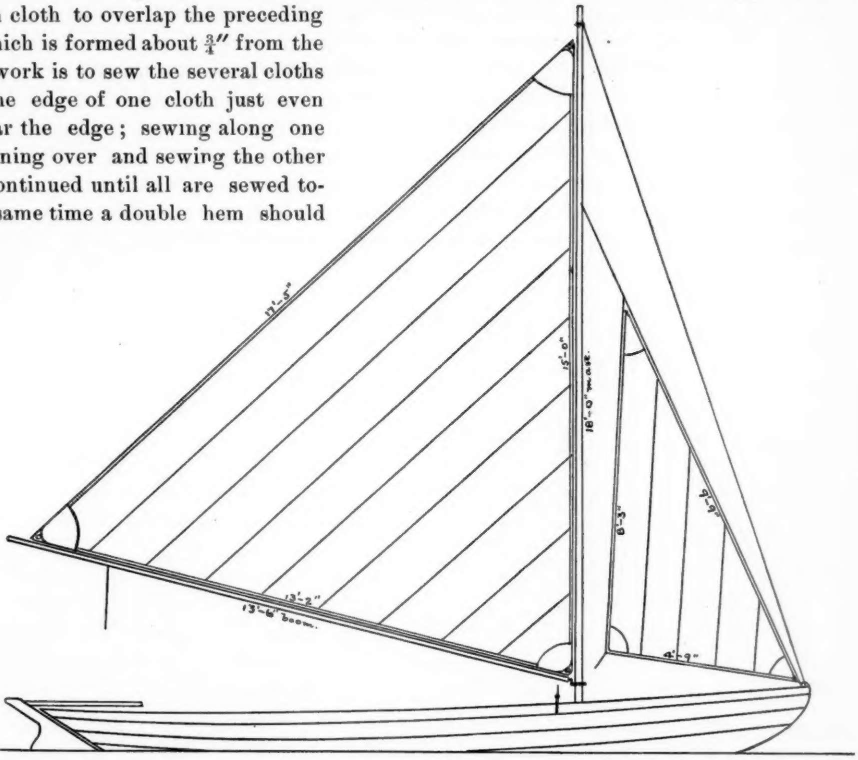
The sail and spar plan shows the length of the spars and the several dimensions of the sails. The mast and boom are of spruce; the former is 18′ long, 3″ in diameter at the foot, running nearly the same to within about 3′ of the top, then tapering to 2″ at the top. The boom is $13\frac{1}{2}'$ long, $2\frac{1}{2}''$ diameter in the middle, tapering to 2″ at each end. These spars may be gotten out of small spruce trees, such as are commonly sold for flag poles, or they may be worked out of square stock obtained at a lumber yard. In either case they are first worked square to the proper size and to the right taper; the corners are then taken off, making them octagonal. The corners are gradually worked off into the round with a plane and then smoothed up. They are finally sandpapered smooth and given a coat of white shellac; after which they are again smoothed up and given two coats of good spar varnish. To fasten the boom to the mast a gooseneck should be purchased, as it is the neatest in the end. It consists of a band which encircles the mast and is fitted with a socket to take the end of the boom. The end of the boom, where the prong of the gooseneck is driven in, should be fitted with a galvanized iron band, driven on to prevent splitting. The top of the mast should be cut down somewhat smaller to form a shoulder. A galvanized iron band having four eyes on it, is slipped over the top of the mast and bears on the shoulder.

The mast is fitted with three stays of $\frac{3}{16}''$ galvanized wire rope, one on each side, and a forestay leading down to the stem. All the stays should be made fast to the masthead, either by splicing, which is the neatest and strongest way, or by bending the end down next to the standing part and winding tightly with marline. Where the rope passes through an eye it must not be bent sharply, but must be fitted with a thimble, such as is sold for the purpose. The forestay is fitted with hooks and turnbuckles, which allow the mast and rigging to be unshipped easily when desired and set up tightly with no trouble. The eye on the back of the mast is to take a single halliard block to raise the mainsail.

For the sails, what is known as "heavy drill" is to be used. It comes usually in 30″ widths, about 16 yards being required for both sails. The dimensions of the sails are shown, but they should be made somewhat shorter—about 6″ on the boom and mast—to allow for stretch. They may be made by sewing the pieces together edgewise, making a sail with no "bights," as they are termed, but it is advised to make a single bight in each cloth, as it is far stronger and stretches much less. To do this, a "bight," or tuck, should be turned over in the middle of the cloth and run the full length; it is about $\frac{3}{4}''$ wide, and should be sewed on each edge. The outline of the mainsail should be laid out on a floor in chalk,

according to the dimensions given, and then shortened, as above directed, on boom and mast. The strip of cloth is laid on the outline and cut off about 3″ outside of and parallel with the line. The cloth may then be turned over, the angle just cut being correct for the end of the next cloth. It is then cut at the other end and again turned over for the next width. In this way all the cloths are cut, allowing each cloth to overlap the preceding one to the line which is formed about ¾″ from the edge. The next work is to sew the several cloths together, with the edge of one cloth just even with the line near the edge; sewing along one edge and then turning over and sewing the other edge. This is continued until all are sewed together. At the same time a double hem should be turned in the edge of the outer cloth and double sewed.

The sail is then laid on the outline and trimmed off to within 2″ of the true shape, the edge then turned over ½″ and again turned over 1½″, which brings the sail the correct size and gives a double edge at the edge of the hem. It is then sewed at the inner and outer edges of the turn, and perhaps once between. The corners should be rounded. At the corners triangular reinforcing patches should be sewed to take the strain. The sail must now be bound with a bolt rope along the hoist, and the foot with about 13/16″ rope; it is sewed on with a sail needle and twine. An eye, or round thimble is sewed on to each corner for fastening, and eyes are worked on the hoist and foot about 12″ apart. The procedure in making the jib is just the same, except that the bolt rope is on the stay and lower edges and, if desired, the jib may be made first to get the practice for making the larger sail. As many mast hoops, 4″ in diameter, are to be obtained as there are eyes on the hoist of the mainsail, and are shipped on the mast. The eyes on the hoist of the sail are then fastened to the hoops, and the foot of the sail is laced to the boom with a small cotton line. A piece of 9-thread manila rope is used for a halliard, and a corresponding piece fastened to the boom to serve as a main sheet. A snap hook is fastened to the eye in the lower corner of the jib and snapped into an eye on the stern. The pulley for the jib halliard is fastened to one of the upper mast hoops. The mainsail halliard should be brought down to a cleat on one side of the mast and the jib halliard one the other. A jib sheet should be led from the eye on the jib aft on either side of the mast. Cleats for main and jib sheets are to be placed where most convenient.



PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

IV. Face Plate—Hand Wheel—Core Pulley and Core Prints.

The wood turning lathe is a most useful machine to the pattern maker in shaping to the required form many of the common types of patterns. The lathe adapted for pattern work should be strongly framed and steady, in order to withstand the vibration resulting from the high speed at which it is driven. It should be of good and durable workmanship, the parts requiring frequent adjustment being provided with the quickest and simplest means of accomplishing that end.

means. In the case of a regular wood turner, the work many times does not require turning to exact dimensions, a smooth finish being usually of greater importance.

The pattern maker generally turns small work just as the regular wood turner would, with a skew chisel beveled on both sides. In the case of heavy work, especially when turning "built up" patterns, the work is frequently fastened securely in a lathe, and a sliding rest, similar to

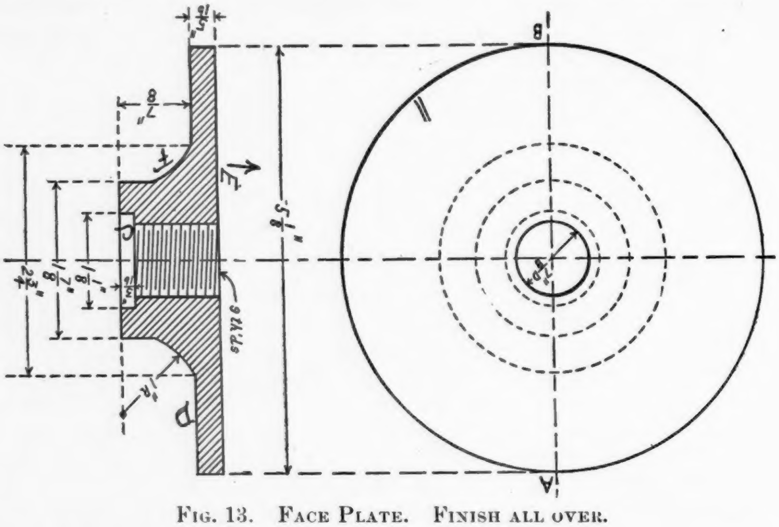


FIG. 13. FACE PLATE. FINISH ALL OVER.

that employed in the metal working lathe, placed before it, the turning being done by means of tools held in the rest.

The operation of pattern turning for large patterns is carried on in a rather different manner from the ordinary work of the wood turner. The pattern maker does not ordinarily use a tool ground on both sides and held sidewise for finishing, as does the wood turner, but instead, employs a thick chisel ground on one side only, with which he scrapes the work by firmly holding the chisel flatwise on the rest. Pattern makers turn in this way because the work must be approximately round and of exact size, the finish being then of minor importance, and also because it is possible to produce this finish later by other

The patterns described in this chapter can all be turned on a lathe with a 6″ swing, and, therefore, the amateur pattern maker will find that the 6″ "Amateur Bench Lathe" offered as a premium by the publishers of "AMATEUR WORK" will serve admirably for this work. I shall assume that the reader has carefully followed my series of articles on "Wood Turning for Amateurs," and has become familiar with the elementary principles of wood turning as applied to the

various exercises described in that above series of articles, and shall confine myself to a few special directions for the turning of the following patterns.

FACE PLATE.

Fig. 13 is a drawing of a finished face plate. The pattern will be of the same shape as the face plate, which is to be finished all over. Use a piece of clear dry pine for this pattern, 5 $\frac{3}{4}''$ square and 1 $\frac{1}{2}''$ thick. First plane one side perfectly true and on this side mark out a circle 5 $\frac{5}{8}''$ in diameter, cutting the block down to the circle just marked with a turn saw, if available, or approximating the circle with a back saw and paring chisel. This block is to be fastened to a screw centre plate with the planed side against the plate, this planed surface becoming the top surface of the finished pattern.

The threaded hole is to be drilled out and the thread cut after the casting has been made. The little recess at *C*, Fig. 13, will, however, be cored out in the mold, the recess cut in the pattern leaving a small green sand core projecting up from the bottom of the mold. In turning this pattern remember that *E*, Fig. 13, is the top side of the pattern, and also that the necessary allowances for finish and shrinkage, as well as a little draft, must be made. The surface *D* must be kept straight and should be tested with a scale or try square. Use a round nose chisel for turning the large fillet at *F*, Fig. 13.

Having brought the pattern, as nearly as possible, to the required size and form with the turning tools, it is necessary to consider those final processes which so much add to the appearance and smoothness of pattern work. The first of these processes is *Sandpapering*. The beginner often hurries his work thinking that sandpaper will hide the defects, and bring it all right. This idea is wrong, for, let a pattern be ever so carefully shaped and turned, if the sandpaper is carelessly applied, the sharpness of its outline will be destroyed and very likely its size and shape will be noticably changed. So, while we respect sandpaper, let us respect our tools more, and bring the pattern to as near the form required as is possible with the cutting tools, and then let the sandpaper be applied, not by folding it together and rubbing it upon the work, but by considering the outline we intend to finish and preparing a piece of wood for a *rubber*, to correspond to the shape. A flat surface requires a flat rubber, a convex surface a concave rubber, etc.

Having turned and sandpapered the pattern, as already directed, the next proceeding is to stop up all holes or cracks that are not to show in the casting, with either beeswax or putty. This is a simple process but it takes a good deal of practice to determine just the proper amount necessary for each hole or crack, so as not to require much time in trimming off the surplus. The wax is formed into a worm like shape, and with the heated point of a knife, not hot enough to make the wax run freely but only to cut it easily, the wax is pressed into the hole.

The third and last of the finishing processes is the application of the spirit varnish as mentioned in the last article. Varnishing lathe work cannot be done while running the lathe, but after the work is varnished, running the lathe will hasten the drying.

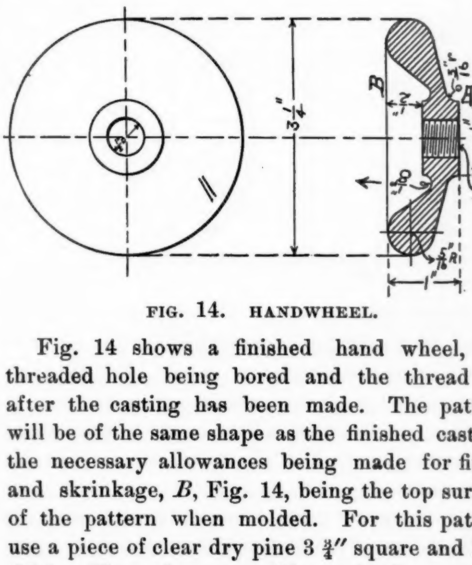


FIG. 14. HANDWHEEL.

Fig. 14 shows a finished hand wheel, the threaded hole being bored and the thread cut after the casting has been made. The pattern will be of the same shape as the finished casting, the necessary allowances being made for finish and skrinkage, *B*, Fig. 14, being the top surface of the pattern when molded. For this pattern use a piece of clear dry pine 3 $\frac{3}{4}''$ square and 1 $\frac{3}{8}''$ thick. First plane one side perfectly true and on this side, mark out a circle, 3 $\frac{5}{8}''$ in diameter, cutting the block down to the circle, following directions previously given. This block is to be fastened to a screw centre plate, the finished side *A*, Fig. 14, coming against a back piece which in turn comes against the face plate. If the screw centre plate has a long centre screw use a back piece, as indicated above, the block being then

clear of the plate by an amount equal to the thickness of the back piece. This will enable the turner to finish the back curve near *A*, with a $\frac{1}{4}''$ round nose chisel.

If the centre screw is not long enough to permit the use of a back piece, the front side and the edge of the pattern may be finished and then chucked so as to finish the back surface, or the pattern may be turned from a block. In this latter case the extra amount of thickness will serve as a back piece and may be reduced with a parting tool to 1$''$ diameter, thus allowing of the finishing of the back of the pattern with the $\frac{1}{4}''$ round nose chisel, after which the pattern is to be sandpapered and nearly cut off with the acute point of a skew chisel, care being taken not to hit the centre screw. This surface would then be the surface *A*, Fig. 14, and should be carefully trued up.

In turning this pattern templates should be cut out and used to enable the turner to easily obtain the desired outline. The molding of this pattern, as well as those previously given, will be taken up in a later chapter.

CONE PULLEYS.

This is a much more difficult pattern to make, as it is to be built up from three blocks, is more difficult to turn, and requires great care in molding. Fig. 15 represents the shape of the finished casting, the hole *G* being drilled out after the casting is made. The right end view in this figure is a half section drawing showing the three pieces from which the pattern is made. Do not forget the necessary allowances for finish and shrinkage, and in turning this pattern be very liberal with the draft allowance, particularly with the surface enclosing the spaces at *E* and *F*, Fig. 15. *A* is the top surface of the pattern when molded, and the arrow indicates the direction in which the pattern is drawn from the mold. The spaces at *E* and *F* in the finished casting are left by a green sand core, formed as part of the *cope*, and right here let me say that I assume that the pattern maker has carefully read my article on "Simple Castings in Type Metal," which appeared in a previous issue of AMATEUR WORK. I shall use the terms *cope*, *nowell*, etc., as defined in that article, many times in describing the next few patterns.

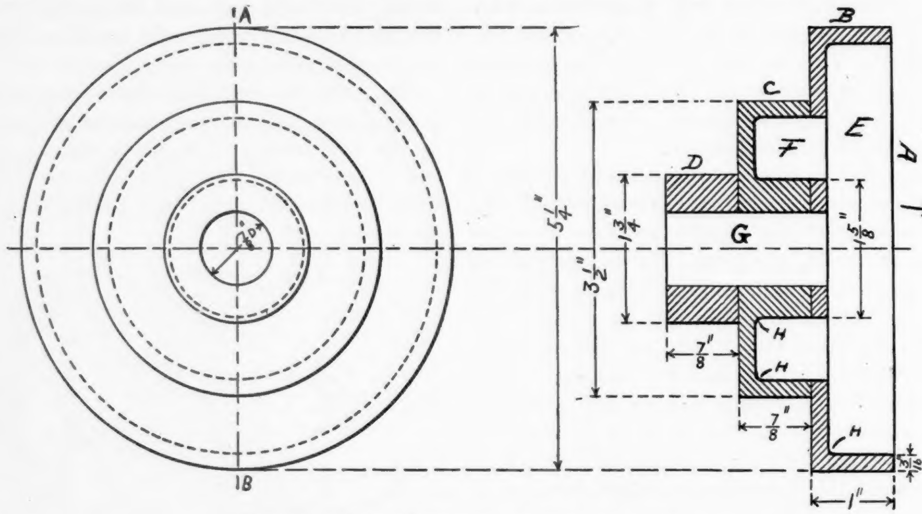


FIG. 15. CONE PULLEY. FINISH ALL OVER.

This pattern is to be built up from three blocks, *B*, *C*, *D*, Fig. 15, planed true on both sides to the thicknesses as given below. The block *B* should be planed to $1\frac{1}{4}''$ in thickness cut round, $5\frac{5}{8}''$ diameter. The block *C* should be planed to $1\frac{1}{16}''$ in thickness cut round. $3\frac{7}{8}''$ diameter. The block D should be planed to $1\frac{1}{16}''$ in thickness and cut round to 2$''$ diameter. Using hot glue, fasten the pieces together, being sure that each is carefully centred, and clamp in a vise to dry. The block *D* may also be fastened to *C* with $1\frac{1}{2}''$ No. 16

wire brads, care being taken to drive these brads straight, after which set in the heads $\frac{3}{16}''$ with a nail set.

The glued block when thoroughly dry is to be fastened to a screw centre plate, the surface *A*, Fig. 15, coming against the plate. The outside surface of the pulley is then turned, care being to keep the shoulders straight and to give the belt surfaces the necessary draft. Having finished the turning of the outside surfaces, sandpaper them carefully and remove block from screw centre plate.

The pattern is next to be chucked, the chuck preferably holding the pattern at the surface *C*. This will require a chuck about $2\frac{1}{4}''$ in thickness. The chuck is fastened by screws to a face plate. Care must be taken in cutting the recess which is to receive the pattern, not to get it too large. In turning the surfaces enclosing the spaces at *E* and *F*, Fig. 15, notice that small fillets are to be turned as indicated in the figure at *H*. These surfaces which, as previously stated, will require a liberal allowance for draft should be very carefully sandpapered. The pattern is then to be finished as previously described.

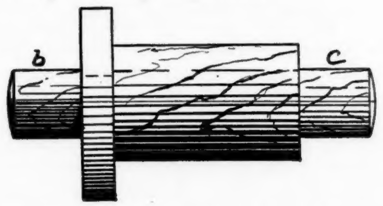


FIG. 16. PATTERN WITH CORE PRINTS.

In a previous article I have spoken of the *green sand core*, and shall now briefly describe *baked sand cores*, first giving the following standard definition of cores by Rose: "Cores are projecting bodies of sand, either left in the mold by the pattern itself or else made in a separate device called a core box. They are placed, after being dried, in position in the mold. The purpose of a core of the latter description is to leave a hole or recess of such a peculiar shape that it is impracticable to make the mold of the necessary conformation by the use of the pattern alone. The use of these cores also permits us to modify the shape of a pattern that would otherwise be difficult to mold."

When it is not possible then, or when it is not convenient to have the cores left by the pattern, they are formed in separate devices called *Core Boxes*. The core box is considered as a part of the pattern or patterns with which it goes, the pattern and core box together forming a *set*. In

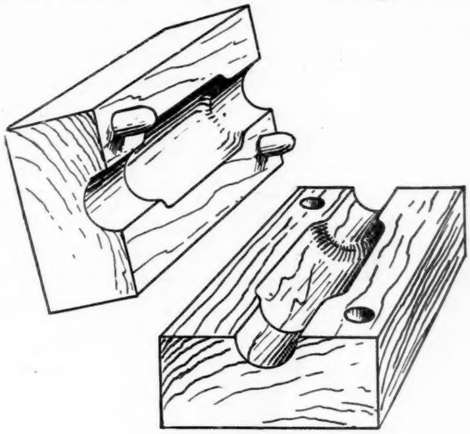


FIG. 17. CORE BOX.

Fig. 16 is shown a pattern having core prints at *B* and *C*. The core box for making this core is shown in Fig. 17, and the mold with the core in place is shown in Fig. 18.

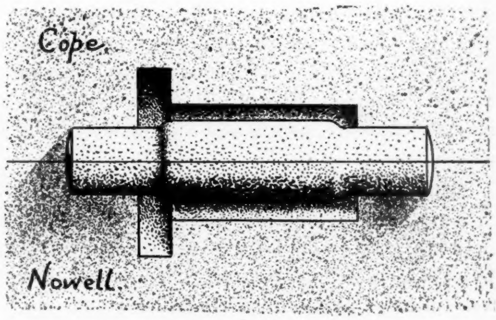


FIG. 18. MOLD WITH CORE.

When a large number of standard cores of the same size are required, as, for instance, the small round cores used in making holes through the hubs of pulleys, and in other works of a similar character, metal core boxes are often used.

Core Boxes require just as much care in the making as do the patterns, and just as much attention must be given to their shape, durability and finish. The shape of the pattern is usually very nearly like that of the required casting, ex-

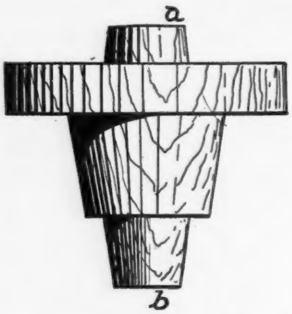
cept that it may have no holes or openings in it. The openings in the core box resembles the openings in the casting.

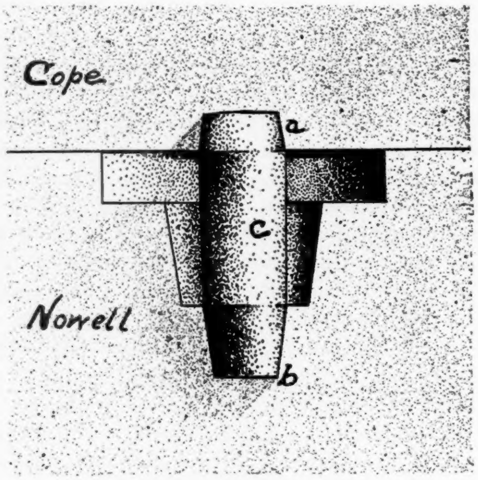
CORE PRINTS.

When cores are made in core boxes and placed in the mold it becomes necessary to support them in such a manner that there can be no possible chance for a change of position during the time the mold is being filled with the hot metal. To give the core this support, special recesses are made in the mold to receive them. These recesses are made by attaching pieces called *Core Prints* to the pattern, as shown at *A* and *B* Fig. 19. These core prints should be colored differently from the rest of the pattern, so that the molder may readily distinguish where the cores are to be placed. For our work we we will use orange shellac for core prints and the inside surface of core boxes.

As cores are always a source of more or less trouble to the molder, these prints should be made of such a shape and size as will give the least trouble to the molders. The core should exactly fill the recess left by the core print, and the core print should be made large enough so that the recess left in the sand will not be crushed out of shape by the weight of the core or the action of the molten metal. Large core prints for vertical cores should be tapered, so that the trouble of withdrawing the pattern from the sand may not be increased by their presence, and also that the core may be easily placed in the mold. Core prints leaving recesses for a horizontal core should have plenty of draft in each end to facilitate in drawing the pattern readily from the sand.

Fig. 20 shows a mold made by the patterns shown in Fig 19. The ends of the core *C* fit in the recesses left by the core prints, as shown at *A* and *B*.





FIGS. 19 AND 20. PATTERN AND MOLD SHOWING CORE PRINT.

Outside illumination at the St. Louis World's Fair is to be carried out on a grand scale. The contracts provides for 300,000 incandescent lamps for lighting the exhibit places, grounds, and architectural features of the exposition proper, but not for state, national, and private concession buildings. Twelve thousand lamps alone are to be placed on the Palace of Education, this affording an excellent setting for night effects. The illumination of the grounds is to be carried out on very ambitious lines. Each monumental standard will carry twenty four incandescent lamps so distributed that twelve will hang on each arm of the supporting post. The lighting of the inside of the buildings will be accomplished entirely with arc lamps.

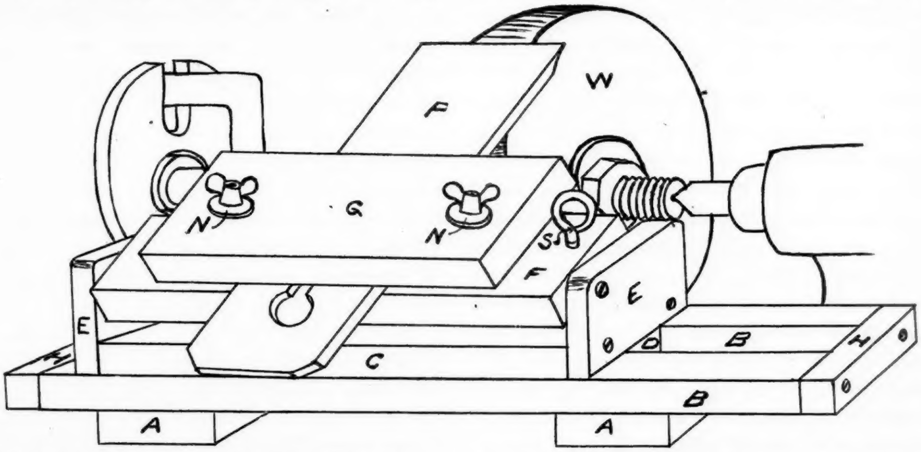
German papers state that the French Government is at present considering the question of the use of white lead and other lead mixtures for painting houses. A committee of the Chamber of Deputies has been appointed to investigate the matter, and Mr. Breton, one of the experts, has been authorized to publish the results of his investigation in pamphlet form. He condemns the addition of white lead to paints and all colors containing it, declaring them to be poisonous in a large degree, both for the workmen and for the inhabitants of a house painted with lead colors. He recommends the use of zinc white instead, which, for surfaces exposed to the sea air, is also much more practicable. He expresses the opinion that the absolute disuse of white lead has become an imperative necessity.

TOOL SHARPENING DEVICE.

F. A. DRAPER.

Unless one has had considerable practice, the sharpening of wide chisels and plane irons on a emery wheel is quite likely to be an unsatisfactory operation, the difficulty being to get a perfectly straight edge at an even bevel. The easily made device here to be described will enable the most inexperienced to do good work without requiring particular care on the part of the operator. It can be attached to a lathe and used with an emery wheel mounted on an arbor, or by means of proper supports easily adapted to a regular grinding wheel or grindstone. The dimensions given are dependent upon the size of the lathe or wheel, but can easily be figured out to any desired size. It is best made out of maple, or other medium hard clear grained wood.

The pieces *A*, are supports, the rear ends being bolted to the top of the bed. Strips 2″ wide and ⅞″ thick will be quite strong enough. A rectangular frame, *B* and *H*, made of pieces ¾″ square and 8 or 9″ long, the centre space being as full as ¾″ wide, is then fastened with screws to the pieces *A*, the screws being put through from the under side, one in each piece *B*. The slide is made of the piece *C* 4″ long, 2 ¼″ wide, and ¾″ thick; the piece *D* a scant ¾″ square and 4″ long and two pieces *E*, 2 ¼″ long, 2″ high and ½″ thick. The piece *D* is glued to the centre of the under side of *C*, the ends *E* are attached with long screws to the ends of *C*. Holes are bored in the upper front corners of the ends *E* to receive large, round-head screws put into the ends of the piece *F*.



The tool holder consists of the piece *F*, 3 ⅞″ long, 2″ wide and ½″ thick, and the piece *G*, 3 ¼″ long, 2″ wide and ½″ thick. The left ends of pieces *F* and *G* are held flush, and holes for small bolts with thumb nuts *N* are bored ⅜″ from each end of *G*. The heads of the bolts are then fitted into the under side of *F*, and washers placed under the thumb nuts on *G*. A large screw eye *S* is then put through the right end of *F*, on the rear side, the lower end resting on the piece *C*. Two screws are then put through the end pieces *F* into the centre of the front ends of *F* forming bearings for the tool holder. The tool *P* is put between the pieces *F* and *G*, fastened in place by tightening the thumb nuts *N*, and then adjusted to rest on the emery wheel *W*, at the desired angle by means of the screw eye *S*.

In sharpening the tool, the slide is pushed back and forth, graphite being used to lubricate the surfaces of *B* and *D*. About the only precaution to be observed is that of adjusting the ways *B* and the tool so that they will be square with the arbor of the emery wheel, the bevel on the tool being regulated by the distance it projects from the holder towards the emery wheel.

LANTERN SLIDE MAKING.

R. G. HARRIS.

V. Clouds in Lantern Slides—Combining Slides for Cloud Effects.

Lantern slides without clouds, are now as rarely seen as are prints without them. At the present time the percentage of landscape negatives that do not show clouds in them is small indeed compared with what it was fifteen years ago. The orthocramatic plate, coupled with the use of a light filter makes the retention of clouds in landscape negatives an easy matter; and when even these are not used, the fact that nine-tenths of the exposures made are shutter exposures accounts for the great prevalence of clouds in the negatives of today.

The lantern slide worker, more than any other, should make a special effort to obtain his negatives with clouds in them, for by so doing he will obviate a large amount of subsequent work. Perhaps in his landscape negatives clouds already exist, but owing to their greater opacity they do not show well defined in the print, in such a case the sky portion should be carefully reduced with ferricyanide or persulphate until the clouds assume an opacity of equal printing value with the landscape portion. In some cases the sky portion of the negative exceeds in density the landscape portion by only a small amount, and it is not desirable to interfere with the opacity. Where this is the case, the landscape portion should be screened during exposure, when making the slide, so that the denser may have a few seconds additional exposure. There will, however, always be a certain proportion of slides which necessitate the introduction of clouds from other negatives, so that it is essential for the slide maker to be proficient in the methods whereby clouds are introduced into slides that show no trace of them.

Two methods are generally available; the clouds may be printed on a separate lantern plate from a specially made cloud negative, and this cloud slide used as a cover glass, or they may be printed on the same plate as the landscape portion in the camera by double printing. These two methods will now be described in detail, preference being given to the first, or "cover-glass method."

It is essential that the slide maker, who has the prospect of much landscape work before him, should be well stocked with cloud negatives of every description, specially taken and developed, so that he can at any time select a suitable cloud effect for any particular landscape. I recommend that prints from these cloud negatives be mounted in a rough album, and the time of the day when the negative was taken, with the compass direction of lighting, be written underneath. There will then be no danger of bizarre and contradictory cloud effects being shown on the screen. In these cloud negatives no portion of the landscape should show; if it is impossible to avoid obtaining some portion when taking the negatives, the landscape should be blocked out by gumming some non-actinic paper upon the reverse side of the negative.

Having obtained a lantern slide of the landscape portion see that the sky part of the slide is represented by absolutely bare glass. If the negative has its sky portion blocked out this will secure perfectly pure glass in the lantern slide, but should any deposit be apparent in the slide it must be cleared away by the application of the ferricyanide reducer, applied with a small tuft of cotton wool. The slide is washed and dried in the usual manner. To make the cloud portion, take another lantern plate, and, having selected a suitable cloud negative make a lantern slide of this. The cloud negative must be adjusted in the camera so as to occupy the position on the plate that will enable it to fit in the clear portion of the landscape. All that is necessary is to hold the landscape slide over the image of the cloud negative shown on the focussing screen, when it will be seen at once if the two correspond. Expose and develop, taking care to work under the same conditions as when making the landscape so that the colors of both may be the same.

On removing the plate from the fixing bath

and comparing it with the landscape portion it will at once be seen how nearly they correspond with each other. Here, now, is seen the value of reduction and intensification in slide work. Perhaps the sky slide requires a slight intensification to bring it up to the landscape portion, or it may be denser and require a brief application of ferricyanide reducer. Having made the two slides of equal opacity, place them back to back, with the edges of the slides even. It will at once be apparent whether the two dovetail into each other, or whether the sky slide overlaps the landscape slide and give a bad effect. Should the sky slide encroach on the landscape anywhere, take a tuft of cotton wool, dip it in the ferricyanide reducer, and, still holding the slide back to back, carefully remove the portion of the sky slide that overlaps the landscape. Do not use the reducer too strong, and see that none of the reducer reaches the landscape by capillary attraction.

When the slides are dry and bound film to film the sky and landscape portions should fit and form a perfect slide. This is the best method of obtaining clouds in lantern slides; but it has one drawback, when developing for warm colors it is not always easy to closely match the two slides. For this reason it is best, whenever possible, to expose the sky and landscape plates one after the other and develop them together. Another means of ameliorating the difficulty is to prepare a stock of sky slides during leisure moments, so that some variety may enable the slide maker to effect a match.

The second method, that of printing the clouds on the same plate as the landscape, is not quite so certain as the method just described. Having selected the cloud negative it is desired to incorporate with the landscape, a mask has to be prepared with which to screen the landscape portion during the exposure of the cloud negative. To prepare this mask, take a piece of nonactinic paper, lay it over the landscape negative, and holding the negative up to a strong light, roughly trace with a pencil on the paper the outline of the landscape where it comes against the sky. Cut out the landscape portion along this line so that two masks result, one for the sky and the other for the landscape. For convenience, the landscape mask may be gummed on a piece of cardboard, leaving the outline of the landscape projecting beyond the stiff of the cardboard. The stiffening is an advantage, as it enables the mask to be held more securely by them and during exposure.

Place the landscape negative in the camera and expose on the lantern plate in the usual manner. Then remove the landscape negative and insert the cloud negative, taking care that it is placed in the same relative position that the landscape negative occupied. Now hold the cardboard mask in front of the cloud negative so that it covers that portion of the negative corresponding to the landscape negative. The mask requires holding about an inch away from the negative, and should be kept moving slightly above and below what would be considered to be the line of junction of the landscape and sky portions. It will thus be seen that the sky negative is vignetted into the landscape portion in the camera, so that both are obtained upon the one lantern plate. A little practice enables this to be done in a very neat manner, but this method is probably not so easy for the beginner as the one previously described.

It should be borne in mind that the same necessity exists in this second method for obtaining the landscape portion with the sky showing as clear glass, otherwise on removing the landscape negative and inserting the cloud negative a brilliant result will not be obtainable. If the sky portion of the landscape negative is not sufficiently dense to give freedom from deposit in the slide, that portion of the paper mask covering the sky should be roughly placed in position during the exposure of the landscape negative to insure this end. *Photography.*

Another step in the direction of technical education has been made in the city of Dresden in the establishment of a school for locomotive driver apprentices. The purpose of the new school, which is managed in connection with the Dresden Technical School, is to equip men who are to become locomotive drivers. The school is for apprentices between 25 and 30 years of age who are employed in the Dresden car shops. Among the subjects taught are German, arithmetic, graphics, and the mechanism of locomotives.

Note the premium offer on the editorial page; many premiums can easily be secured in this way. Try it.

AMATEUR WORK

77 KILBY ST., BOSTON

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Entered at the Post-office, Boston, as second-class mail matter Jan. 14, 1902.

JUNE, 1904.

At the solicitation of many of our readers we have decided to offer premiums for the sale of single copies of the magazine:—To anyone selling 12 copies, the premium for one yearly subscription will be given. Anyone selling 25 copies may have their own subscription extended one year. It should be a very easy matter for many to secure a few orders for each issue of the magazine, and when the necessary number have been secured, obtain a premium. Should the desired premium call for the sale of more than 12 copies, a record will be kept and the premium sent when the number of copies are sold, necessary to secure it. Regular subscribers, desiring to secure premiums under this plan, may order the number of copies they find they can sell, remitting for same after delivery to customers, but within 30 days. Readers whose names are not on our subscription list should send money with order. Unsold copies cannot be returned, as handling them is liable to so deface them as to make them unsalable, so only the number should be ordered which can surely be sold. A little work each month will enable anyone to secure many useful tools, the turning lathe, or some other valuable premium. Try it.

Arrangements are being perfected for a considerable increase in the size of the magaztne, and the opening of several new departments, all of which will increase the interest manifested by our readers in all sections of the country, and which we gratefully acknowledge.

Do not send stamps with orders during the warm season unless fully protected by gummed paper.

The most curious specimens of vegetable or plant life in existence are the so called "living stones" of the Falkland Islands. Those islands are among the most cheerless spots in the world, being constantly subjected to a strong Polar wind. In such a climate it is impossible for trees to grow erect as they do in other countries; but Nature has made amends by furnishing a supply of wood in the most curious shape imaginable. The visitor to the Falklands, says an American writer, sees scattered here and there singular-shaped blocks of what appear to be weather beaten and moss covered boulders in various sizes. Attempt to turn one of these boulders over and you will meet with an actual surprise, because the stone is actually anchored by roots of great strength; in fact, you will find that you are fooling with one of the native trees. No other country in the world has such a peculiar "forest" growth, and it is said to be next to impossible to work the odd shaped blocks into fuel, because the wood is perfectly devoid of grain, and appears to be a twisted mass of woody fibres.

Timing clocks electrically by the Western Union Telegraph Company of America is said to bring in a revenue of more than $1,000,000. The company keeps 70,000 clocks going on correct time at an average charge of apparently a little more than a shilling a week each. The clocks are set at noon each day by an automatic arrangement connected with the great sidereal clock in the National Observatory at Washington. A few minutes before noon every day business over the Western Union wires is suspended, and operators through the country put their instruments in shape to form an unbroken circuit from the observatory to every place where ticks a clock to be electrically influenced. When the time ball strikes, the time message immediately flashes over the wires.

TELEPHONE CIRCUITS AND WIRING.

ARTHUR H. BELL.

I. A Simple Arrangement for Short Lines.

The subject of telephones and their application to private uses is a matter sparsely treated in electrical text books and technical publications. Much importance has been given, in such works as have been offered to the public, to detailed descriptions of the construction of various types of transmitters, receivers, and similar apparatus, from earliest days of experiment to modern times, and but little space has been devoted to the arranging of systems of easy practical communication between two or more distant points, with such diagrams of circuits as will help the non-technical reader to establish telephone service without the aid of a practical telephone electrician.

In this, and the following chapters, the ordinary transmitter or receiver will be treated purely as an article of commerce, for sale at reasonable prices and returnable as junk when rendered worthless by long service.

What interests the layman most, is not what distinctive electrical features one type of apparatus possesses over another, but by what method any good type, of which there are scores in the market, may be connected together for house to stable, room to room, or factory to office service.

It is the purpose of this article to cover intelligently a number of circuits of value to readers in all parts of the country. Possibly many arrangements best adapted to one's specific needs may not be treated until later chapters, but it is advisable for the reader to follow all of the circuits as they are explained, thereby gaining a liberal understanding of wiring methods.

The most simple arrangement of the telephone is a circuit, Fig. 1, comprising two ordinary receivers and a cell of battery. Conversation by this method is limited to short distances and not worthy the trouble of connecting the apparatus except for experiment.

The next arrangement is the addition of a pair of transmitters to the circuit, as in Fig. 2. The same circuit, with battery at each end, will facilitate talking. This permits easy conversation for

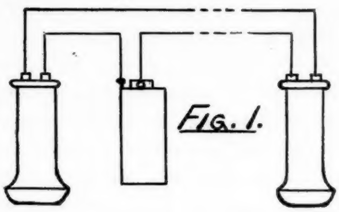


Fig. 1.

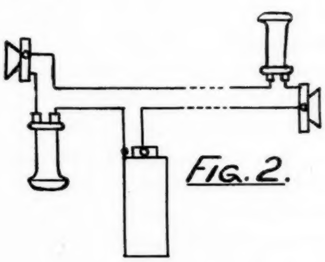


Fig. 2.

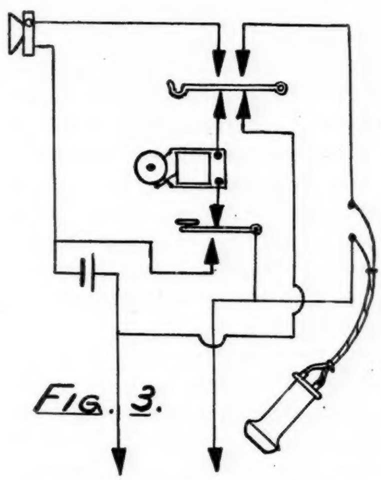


Fig. 3.


Fig. 4.


Fig. 5.

quite a distance, but no means of signaling. It will be noticed that these circuits are closed at all times and consequently would wear constantly upon the battery supply if a switch to open the circuit were not inserted to prevent exhaustion.

A simple method of setting up instruments for practical usage between two points is shown in Fig. 3, where the length of line construction is to be limited to the distance over which an ordinary electric door bell may be operated for signaling. This arrangement is splendidly adapted to room to room or house to stable circuits, where the line length is less than 1000 feet.

This diagram represents the equipment of one station complete, if we spread it out before us for inspection. The hook is, perhaps, the most important part, as everything depends on the proper make and break of the contacts when the receiver is taken off and replaced. The receiver must be kept on the hook when not in use.

Let us now discuss the circuit piece by piece. One side of the line takes one side of the battery. The other terminal of the transmitter goes to one of the upper hook contacts. These upper contacts do not touch the metal hook until the receiver is removed. The second upper contact takes a binding post (not shown in the diagram), and after we have connected our flexible receiver cord to the receiver, one of the two ends is connected to this binding post. The other side of the receiver cord goes to a binding post connected with the other side of the line. With the receiver off the hook we are enabled to talk with and hear the party at the other end, because the circuit between transmitter and receiver is established by the hook after it goes up. Now, in signalling it is desirable to utilize the same sets of batteries, and the ringing circuit must be so devised that the downward contact of a strap key will place the battery in circuit across the line, thus ringing the bell at the other station as long as the key is depressed. The key, when restored, makes a contact with a contact point connected with one side of the bell, and the other side of the bell takes a contact point on the other side of the hook. The second under hook contact goes to the side of the line, where we started. It will be readily seen, with the strap key making upward contact and the receiver hook bearing on lower contacts, how a ring from the other end of the line will operate the signal bell. The reader should trace out this circuit until it is fully understood. It is not advisable to operate this system with one side of line grounded; the circuit should be metallic, that is, consisting solely of wires from station to station, to get the best results.

Readers may purchase transmitters and receivers at electrical stores and arrange wiring and working parts inside of a small wooden box, being careful to solder all connections carefully.

It may be observed that no induction coils are used in connection with this set. (On systems designed for short distances the induction coil has no value.) Induction coils are wound and used to raise the transmitted voltage, so as to overcome line resistance. In a subsequent chapter a diagram utilizing an induction coil will be shown.

In placing wires between stations, within doors, a number of important rules of installation must be obeyed. Foremost among these is the rule to avoid at all times crossing of other wires and, in cases where it is absolutely necessary to pass over other circuits, to thoroughly protect your wires by extra thick layers of insulation, from any chance of cross due to direct contact, chafing, unexpected moisture, or breaking of wire or insulation of either circuit.

For interior construction, in residences where neatness and partial secretion of wires is essential, wire known as No. 16 or 18 paired annunciator or office wire may be used, but where wires are to be concealed from close inspection, as under floors or behind sheathing or plastering, strict observance of fire underwriters' rules and rules for wiring as established by municipal legislation is necessary. In cellars and damp places, or places likely to be damp at certain periods, the wire should be well protected by heavy, damp-proof insulation of rubber, or similar compound. In tacking wires to the walls, use as few tacks as possible and avoid setting one tack over two wires of a circuit.

In splicing two pieces of wire together, never make what has been styled a bell hanger's joint, Fig. 4, for such connections are not perfect conductors and would be an endless source of bother. Always scrape the copper wire clean and bright and twist the two ends firmly together and solder securely, Fig. 5; then insulate the splice with a layer of electrician's tape.

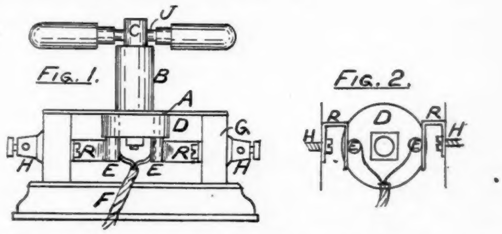
CURRENT REVERSER FOR SPARK COIL.

A spark coil is very incomplete without a commutator. One of a very simple kind, and much easier to make than the usual variety fixed to coils, is figured below. This is a modification of one illustrated in Mr. Hare's book on large induction coils, and on all fours with a reversing switch fitted by Carlisle & Finch, of Cincinnati, to their model motors and electric cars.

A is a piece of stout sheet brass, about $1'' \times 3''$; in the centre of this a hole is made to exactly fit a piece of brass tubing *B*, (triplet tubing used by makers of fishing rods will do for this.) *B* is about an inch in length, and should be soldered to *A* and fixed upright. *C* is a piece of brass tubing $\frac{1}{2}''$ longer than *B*, through which it passes; it should make rather a tight fit in *B*. In one end of *C* fix, by soldering, a small brass bolt, the head of which should just go in the end of tube, and may there be fixed. At the other end of *C*, drill two holes exactly opposite each other, and large enough to take a piece of stout brass rod, *J* about $2''$, this also may be soldered.

D is a thick disc of ebonite. This is secured to the bottom end of *C* by, having drilled a hole, passing it over the brass screw and securing it with the nut. It follows that if the handle or T-piece be turned, the ebonite disc is revolved, anything mounted upon it being quite insulated. The T-piece should be fitted so that the ebonite disc is kept close to the plate *A*, and without shake. *E E* are two brass studs securely inserted at opposite sides in the under side of the ebonite disc. Securely soldered to each is one strand of the best silk and rubber covered twin flexible wire. The best way I think to do this is to get two pieces of the smallest gauge copper or brass tubing, $\frac{3}{16}''$, say. Drill a small hole near one end, and, having bared a strand of the wire, pass it through the hole and out at the end. Then plug this end with a piece of brass rod, and make a perfect joint with solder. The two studs, or short tubes, being done in this way, may then be securely fixed to the disc, as shown. They are, of course, perfectly insulated one from the other by the rubber and silk covering.

The brass platform *A*, is mounted on two wood mahogany blocks, *G-G*, these again glued to a gas block. Two terminals are then attached, as shows, *H H*, and hard brass or German silver springs adjusted, *R R*, so as to make perfect contact with the studs *E E*, as shown in the plan, Fig. 2, where is shown the under side of the ebonite disc, the two studs, and the two springs pressing against them. Ebonite or wood handles are fitted to the T piece, and the protruding end of *C* covered with a little ebonite cap.



The twin wire is attached, one strand to the contact pillar, and the other one to one of the primary wires on the coil. The wires from the battery are then brought to the two terminals, *H H*. The handles being in a line with the base, as in the figure, a current passes, which current is reversed if the handles are turned the reversed way. With the handle set at right angles to the base the current, of course, is switched off.

Mr. Hare's remarks accompanying his design of switch may be quoted:—"In the ordinary commutator there are four joints where resistance may be found viz., at the two bearings of the cylinder, and at the two springs. These may be reduced to two, and the contact much improved."

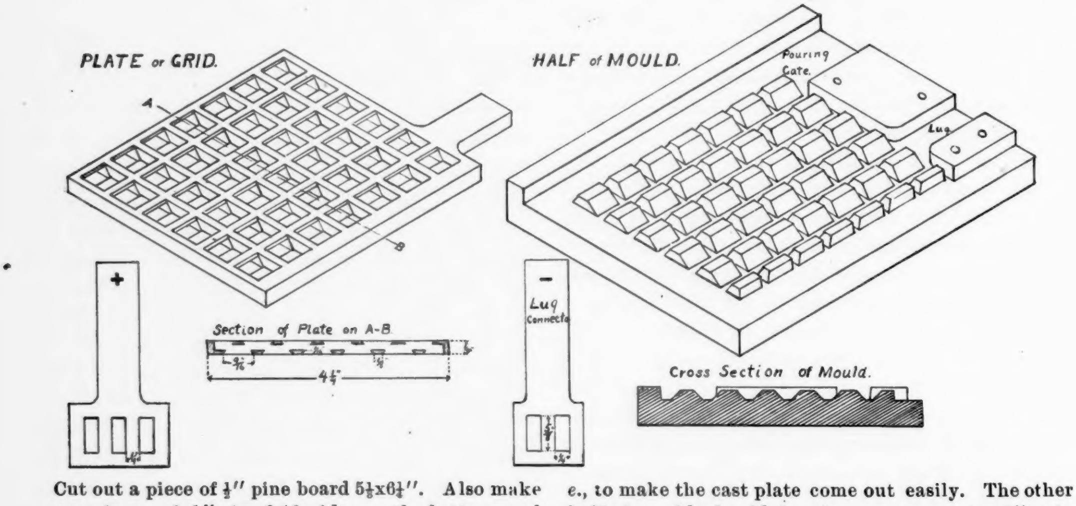
British Journal of Photography.

A despatch from Caribo, Maine, says that a guide who has returned from Tiboque, reports that Bald Mountain, in New Brunswick, has disappeared, its place being occupied by a lake of muddy water. The sinking of the mountain is supposed to be connected with the earthquake felt in New Brunswick and New England States recently. There have always been at the foot of the mountain springs of boiling water supposed to have a volcanic source. The guide's story is confirmed by a number of woodsmen.

A STORAGE BATTERY.

W. C. HOUGHTON.

The battery here described is of the pasted lead plate type and may be made of any desired capacity by using a greater or less number of plates. There are always an odd number of plates, three, five, seven, nine, etc., there being one more negative than positive. The "grid" or lead frame adopted, requires a mould, which may be of wood or iron. A wooden mould, if carefully used, will do for casting a number of plates, but if many are to be made it should be of iron. In this form of mould no machine work is necessary except a little drilling and filing. Whether the wood or the iron mould is to be used, the first step is to make it in wood, only one-half need be made for the iron one. and this is used as a pattern from which two iron castings are made.



Cut out a piece of ½" pine board 5⅛x6¼". Also make seven pieces of ¼" pine 9-16 wide on the bottom. and bevel them off on each side at 45 deg., which will make the top about ⅛" wide. These should be very accurately made, as the success of the job depends on their fitting well.

Take one of these strips and fasten it on the large board 7-16" from the long edge, using small brads and glue. It should be put 9-16" from the lower end. In like manner put on four more strips parallel with the first, using one of the strips placed bottom side up for spacing them. The sixth strip should be planed off on the outer edge to a sharper angle than the others, leaving top as it was, but making the bottom only ⅜" wide, after which it is fastened like the others.

Seven brads should be used in each strip, placing the first one 5-16" from the end, and the others at equal distances of ⅝". When strips are in place cut six notches 3-16" wide at the top, and ⅛" wide at the bottom, crosswise through all the strips down to the board. This may be done with a back-saw, finishing with a knife and a strip of fine sandpaper held on a thin, beveled strip of wood. If the iron mould is to be made, the pattern is now complete, except that it should be given two coats of black shellac. If, on the other hand, it is to be used as a mould it should *not* be shellaced, but a second one should be made and a strip of wood ¼" thick and ⅜" wide, with the inner edge slightly beveled, fastened to the left-hand edge of one of them. Also make two blocks of ¼" wood shaped as shown in drawing to go at the top to make the lug and the pouring-gate. These should be slightly beveled on three edges to give draft to the mould, *i. e.*, to make the cast plate come out easily. The other half of mould should be the same, except a ⅜" strip should be placed at the bottom and no blocks at the top. When placed face to face the halves should fit together all around, making a lead-tight mould. All that remains is to carefully sandpaper off the tops of the little pyramidal blocks, but not the sides and top, to a depth of 1-16", giving space for the metal to flow. If the work has been carefully done the maker is now ready for casting.

First, *chalk* the mould all over inside rather heavily. This helps prevent burning the mould more than necessary, and also makes the lead run more freely. The wood of the mould should be as free of pitch as possible. Next melt the lead, but take great care to have it hot enough to run freely. This is important. Clamp the mould together with wooden hand screws, place

upright and pour as fast as possible without spilling. The whole secret of running lead is to get the metal in quickly, before it has a chance to freeze. After taking out the plate and re-chalking mould, you are ready for casting another. As many as twenty plates can sometimes be cast from one wooden mould.

If the iron mould is decided upon, take the wooden pattern to the foundry and have two castings made from it. Lay one casting face up on the bench, put on some coarse emery and grind the other one to a fit, using water and sliding one plate back and forth till they come together. This will take an hour or two, according to how well the pattern was made. When fitted, file off 1-16" from the face of each half, leaving the pyramids 3-16" high. If the cross notches need a little fitting, that may also be done with a thin file. The mould is then to be finished like the wooden one, by riveting iron strips on sides and top of one and side and bottom of the other.

The iron mould is to be warmed and then heavily *smoked* with a candle or lamp before casting. The lead should be hotter than for the wood mould, as it will run better. The *positive* plates will be better if a little antimony, say ¼ oz., is added to every pound of lead. When you have moulded a sufficient number of plates you are ready to paste them. Each plate will require about 6 oz. of lead oxide. Use red lead or minium, for the positives, aud yellow lead, or litharge, for the negatives. The paste is a kind of mortar made by moistening the lead oxide with a ten per cent solution of sulphuric acid. To mix the acid put a sufficient quantity of water in an earthen jar and add 1-10 the quantity of acid, pouring slowly and stirring with a strip of glass. *Do not* pour water into acid. Mix the lead oxide to a very stiff paste with the acid water, and using a thick piece of glass or a wooden paddle for a trowel, plaster one side of the plates, working the paste well into the holes. Turn over and finish the other side in the same way. Scrape off all surplus paste and put away to dry.

To assemble the battery, cut pieces of burlap of the right size to cover the plates all over except the lug on top, and with coarse cotton cord cover plates tightly, sewing firmly around three edges. The burlap is to be folded over the fourth edge. Next take some sheet lead 1-8" or 3-16" thick and cut out two lug connectors for each cell, as shown in drawings. Next make eight strips of pine wood for each cell ¼x½" and 4½" long. Lay a negative plate on the bench with the lug on the left. Put a wooden strip on each edge. Lay on a positive plate with a lug to the right, then more strips, negative plate, strips, positive plate, and so on, until you have as many as you wish. Three plates will give a capacity of 10 to 12 ampere-hours; five plates, 15 to 20; seven, 25 to 30, and so on. The voltage will be same, no matter how many or how few plates are used, namely, about 2½ volts on open circuit and 2 volts when using normal current. The normal charge or discharge rate is 1-8 to 1-10 of the capacity: that is, the 15 ampere-hour cell should ordinarily be charged or discharged at the rate of 2 amperes and would last about 8 hours at that rate.

When plates are grouped as above, put two or three heavy rubber bands around them and turn the bunch up on end. Fit the lug connections on with the ends pointing outward. Solder them in place, taking care not to overheat and melt the lead. Bend outer ends upward, and your battery is ready to put in the jar of acid and charge. The acid should be about one part sulphuric acid to five of water.

Do not put plates in acid after mixing till it is cool. The jar may be of hard rubber or glass. Suitable jars may be purchased, but are rather expensive. A glass jar of the right size for the five plate cell costs 50 cents. An ordinary round telegraph battery jar, costing only 25 cents, will do; or a large glass bottle may be cut off at the right height, which should be about six inches. The acid should cover the tops of the plates to depth of at least ½". Evaporation of the solution may be prevented by pouring melted paraffine wax on the top of jar to a depth of ¼". Two or three small holes should be made in the wax to allow gas to escape when charging the battery.

The battery may be charged from any source of *direct* current. Alternating current will not do. About 2½ volts per cell will be required. A small dynamo is the best thing for the purpose if power is available. Begin the charge of 15 ampere-hour cells at the rate of 4 or 5 amperes. This rate is to be reduced as the charging proceeds, ending with about half an ampere, which should be continued for six or eight hours, the first few times. The battery will not attain its full capacity till it has been charged and discharged a number of times. This process is what is called forming.

POLARITY INDICATOR.

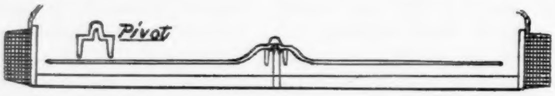
Amateurs frequently desire to learn the polarity of their primary or secondary battery terminals. There are several contrivances constructed of glass and depending upon the coloring of the solution contained therein for a polarity indicator. A simpler method is to cut sheets of white blotting paper into small squares 2 by 2, and saturate the squares with iodine of potassium and allow them to dry. When a test is to be made, moisten a piece of the paper with water and press the battery leads down upon the wet surface about ½ an inch apart. The positive end will turn a pronounced brown, while the negative end does not change.

A strip of glass cut one inch by four, coated with shellac and sprinkled with fine brass or other metal filings, will form a magnificent display when introduced between the balls of a secondary spark, especially at night. A pretty design or a person's name may be traced in minute sparks by this method.

A SIMPLE GALVANOMETER.

JOHN F. ATKINS.

Every amateur should possess an accurate galvanometer for general laboratory testing. While many high grade types of galvanometer are beyond the means of most electrical students, it is possible to construct an efficient instrument for a very small sum. Much of the construction can be done with tools common to every workshop, but there are certain parts which require absolute allignment, and might work more perfectly if fitted by one of experience. A friendly jeweller or machinist could render valuable assistance in half an hour's time, should the amateur be without tools for this part of the work.



First procure a cover to an ordinary, round, wood blueberry box. Cut out a circular piece of cardboard to fit inside the cover, for a dial. Wind as many turns of No. 32 cotton covered magnet wire around the outside edge as may be applied without crowding over the edge, say three layers of 12 turns per layer. Stick the wires together, and to the wood, with quick-drying shellac varnish.

Having found the exact centre of the cover, drill a small hole and insert a small piece of straight, hard, steel wire about 1-16″ diameter and ½″ long. The upper end of this rod should first be turned to a long, highly polished point. The amateur is cautioned to exercise care in fashioning this point, being sure there is no rough, feathery edge to it when completed.

Upon this point is to rest and rotate a pivot to be turned out of a piece of brass rod. The exact size and shape of the pivot is not imperative, but the shape, as shown in the illustration, should be followed quite closely.

A piece of straight ribbon steel, as long as the diameter of the cover, is next procured and cut and bent into shape as illustrated. The exact balance of the strip is next found, and a small hole punched to take the top of the pivot. Next solder the pivot and steel strip together and magnetize the steel by winding insulated wire around it and sending the current from two or three cells of battery through for a short time. Then place the needle in position upon the point and we have practically a compass, for it will be noticed that the needle points to the magnetic pole. By sending battery current through the wire coiled about the cover a deflection takes place; that is, the needle moves from north to another position and remains in that vicinity as long as the current is continued. A couple of binding posts, to the bases of which are attached the ends of the coil and a mark or dot indicating north or zero on the dial, completes the galvanometer.

Now, as to its uses. In a simple galvanometer of this kind we find the needle susceptible to influences of any magnetic metal that may be brought near the instrument while testing. This interferes with accuracy, and care should be taken to see that this is avoided. With this instrument a comparison of current strength may be made, but its principal value is the measuring of resistance in connection with the Wheatstone Bridge. A simple form of bridge was constructed by the writer in less than an hour's time, and a brief description, together with a sketch of it, will be given in another article.

Richard Guenther, U. S. Consul-General, reports that interesting experiments are being conducted at the agricultural bacteriological station of Vienna. It is a well known fact that salts of iron are of great importance for the human system. The artificially prepared foods containing iron which are introduced into the human body have not always the desired effect because the quantities of iron contained therein, even if considerable, are not completely assimilated.

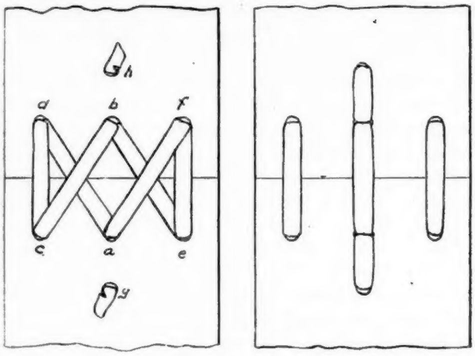
According to modern ideas, the human body may also supply its want of iron from vegetable foods, and it is expected that by increasing the quantity of iron in vegetables it will be possible to procure a natural means of supplying the human system with a nutriment rich in iron and easily assimilated. The first experiment was made with spinach, by adding hydrate of iron to the soil, The spinach grown from seed showed a percentage of iron seven times as great as ordinary spinach, without injury to the plant. This is considered a very favorable result, as the iron contents are perfectly sufficient for medicinal purposes and in a form which possesses none of the defects of the best artificial iron preparations. It is presumed that other ferruginous plants rich in iron will yield similar results, so that not only the science of medicine will be benefited but the gardeners will also find their cultivation a source of profit.

LACING LEATHER BELTS.

The ends of belts are fastened together by means of lacing, threaded through holes punched near the ends of the belts. The lacing is usually an oil-tan leather, prepared especially for the purpose, and obtainable in the various widths and lengths most suitable for the sizes of belts in common use. The following table gives the widths of lacing for different sizes of belts:

Width of Belt.	Width of lacing.
2 inches and under	¼ inch
2 to 6 inches	5-16 "
6 to 12 "	⅜ "

The size of the holes punched for the lacing should be the smallest that will permit of lacing without great difficulty; holes having the effect of reducing the strength of the belt, and large holes failing to keep the lacing tightly in place. The usual practice is to have have ¼ inch holes in belts up to 6 inches wide and 5-16 or ⅜ inch for the greater widths.



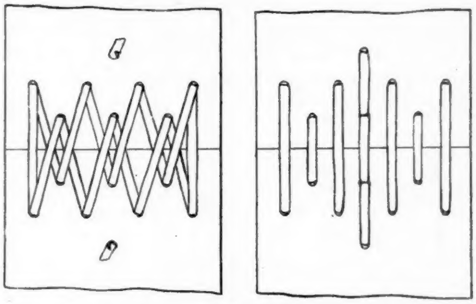
A FIG. 1. B

In cutting the ends of a belt preparatory to lacing, the line for the cut should be marked with a scratch point or pencil along the edge of a square and cut with a sharp knife, as it is absolutely necessary to the even running of the belt that the joint should be square and at right angles with the edges of the belt.

There are several common arrangements for lacing belts, but of the two here given the first is preferred, as in cutting off a piece for the purpose of strengthening the belt, the length cut off is not as long as with the second, the latter being likely to cause too tight a belt if both rows are cut off, and an uneven lacing if only one row is cut off. On only quite long belts can the second style of lacing be used to good advantage.

For even the narrowest widths of belt there should be at least two holes in each end, the illustrations being for a belt three inches wide. For narrow belts omit the centre holes and the lacing for one pair of holes. The holes should centre 1 inch apart and about ⅝ inch from the ends of the belt, and be punched exactly opposite each other. The proper places should be found by measurement until experience has enabled one to do it correctly without. If the holes are not evenly spaced, upon tightening the lace, the edges will be found out of line, and in case it should be running through a shipper, a torn belt is likely to result.

Begin to lace at the centre holes, first passing the lace half through the hole *a* from the under or pulley side of the belt; then pass the other end through the hole *b*; *A*, Fig. 1, showing the back or outside of the belt, and *B* the face or pulley side. Continuing, pass down through hole *d*, up through *c*, down *d* again and up through *c*; then across to *b* and up through *h*, where a notch is cut in the lace about even with the back edge of the belt to prevent the end of the lace from slipping back through the hole. The other end of the lace is then put down through the hole *e*, then up through *f*, down *e* again and up *f*, across to *a* and up through *g*. where the end is notched as described. The holes *g* and *h* should be smaller than the other holes, the lace fitting tightly therein. It will be noted that all crossings of the lace are outside.



A FIG. 2. B

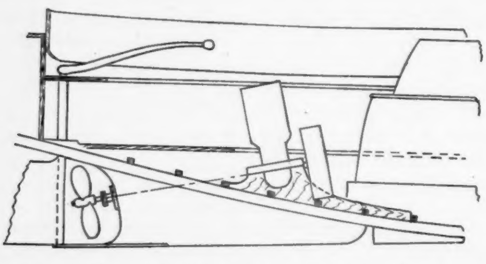
The method shown in Fig. 2 is somewhat stronger than the other, and is best adapted to long belts which will allow both rows of holes to be cut off when tightening, though the belt can be laced in the same manner if only one row is cut off. The arrangement is carried out much the same as with the first method, and is shown so clearly in the illustration that further description should not be necessary. A similar arrangement, much used, places the four-hole rows nearest the ends, but that shown is to be preferred as giving more strength to the edges and, therefore, less likely to tear out should the belt catch on the shipper. The ends of the lacing are put up through the centre holes and then threaded to the holes nearest the edges, two turns being taken through these holes before starting towards the centre holes. One end is carried to a stay hole, and notched to hold it; the other carried down one centre hole and up through the other, notched and the end drawn under the nearest cross lacing, where it should hold all right.

HOW TO BUILD A SAIL-BOAT.

CARL H. CLARK.

VI. Fitting an Engine and Rigging the Sails.

The hull of the boat having been completed in proper manner for use as a sailing boat, it has been thought best, in view of the great increase in power boating, to describe the slight additional labor of fitting an engine of about $1\frac{1}{2}$ or 2 h. p. for auxiliary service. The advantages of a practical combination of the power and sail boats are too well known to need any explanation. The only difference in the boat when so fitted is the addition of the engine beds inside, and the aperature in the skeg to admit of the wheel, as shown in Fig. 1. The top of the cylinder will project above the floor and can be fitted with a removable box to protect it when not in use, and which serves as a seat when in place. It is suggested that those intending to fit power, place the centreboard box about one foot further forward to give rather more room for the engine. The box is now in the proper place for use with sails alone, but placing it a foot further forward will not affect her sailing, and the change in the slot should be made when the keel is sawed. This is only to give additional room, as the engine can be put in with the box in its present position.



The engine should be placed as near the centre board box as possible and allow easy access to the starting handle. The centreboard logs are cut out to admit the fly wheel, which should clear on the lower side by about an inch.

The skeg is cut, as in Fig. 17, to give room for the propeller. The shaft hole is bored in the right place and with the proper slant. The beds inside are about 2″ thick, fitted the proper distance apart to fit the flanges on the engine bed. Some engines require cross beds, like deep, heavy floors, which are easily fitted and fastened to the keel and plank.

A fore and aft bed is to be preferred and is shaped somewhat as in Fig. 1. The bed pieces are notched over the frames and fastened through the plank, and should run well forward. In either case the beds should have a cross brace between them to keep them upright.

Care must be used to prevent the ingress of water at the joint between the skeg and the keel. A stop water, or pine plug, should be driven in the joint about 3″ on either side of the hole, and the joint between them carefully calked. The foot of the rudder, also, must be supported by the iron skeg, which is now made longer for this purpose.

The installation of the engine is described in the chapter on the power dory. The exhaust pipe should be led down alongside the engine and then under the floor to the muffler, which is placed either in the stern or inside one of the seats, as is most convenient. The outlet from the muffler is then carried out through the stern. The gasolene tank may be placed whereever is most convenient, one of about ten gallons being of sufficient capacity. The stern stuffing box, or gland, is fastened on the after side of the skeg with lug screws and must be nicely fitted not to cramp or bend the shaft when set up. The general directions for piping, as given for the power dory, apply equally well to this installation. The position of the wheel in relation to the starting handle, or some other point, should be determined, that the wheel may be placed vertically behind the skeg when under sail.

The sail plan is shown in Fig. 2; that of the jib and mainsail type, as it is the handiest for general use and the most popular rig for small boats. A yawl rig could easily be substituted if the boat is to be used for cruising. The spars are of spruce of the lengths shown in Fig. 2. The mast is 21′ long, 4″ in diameter at the deck, tapering to $3\frac{1}{2}$″ at the gaff and 3″ at the top. It may be gotten out of a square stick of timber or from a small tree, such as are sold for the purpose. If worked out of a square stick it should first be tapered correctly, the corners then taken off, making it octagon, and finally rounding it off smoothly and finishing with sandpaper.

There are three eyes at the top of the mast, the upper as near the top as possible; the next about 8″ below the upper, and the lower about 2′ below the second; they are riveted through over a washer.

The boom is 19′ 8″ long, 3″ in diameter at the middle, $2\frac{1}{2}$″ at the inner and 2″ at the outer end. The inner end is fitted with a band, tightly driven on to prevent it splitting when the end of the gooseneck is driven in. The gaff is 12′ 6″ long, of oval section about $3\frac{1}{2}$″ by $1\frac{1}{2}$″, tapering towards the outer end. The inner end is fitted with jaws which fit the mast. The latter are of oak and may be cut out, or better, may be bought, all bent to shape, at stores dealing in yacht supplies. They are riveted on to the sides of the gaff. There is also an eye in this end for the

throat halliard.

The bowsprit is 4′ outboard, and about $6\frac{1}{2}$′, total length. It is $1\frac{1}{2}$″ thick and 5″ wide at the stem and tapers toward each end. There is a mortise in it to fit over the top of the stem, and two eyes in the outer end one above and one below; these latter must be very strong, as there is much strain upon them. There are

The standing rigging is of $\frac{1}{4}$″ galvanized steel wire. In each of the three stays an eye should be spliced which will just fit the top of the mast and rest upon the middle one of the three eyes, a small oak chock piece should also be screwed to the mast opposite the eye, to prevent their slipping down. At the lower end of each a thimble is spliced, the stays being left of the

two $\frac{1}{2}$″ bolts in the inboard end, fastened with nuts below. To take the lower end of the bobstay a strong eye is fastened to the stem by bolting through. The spars should be smoothly sandpapered and finished with a coat of white shellac and two coats of good spar varnish.

A pair of chain plates are bolted to the hull about 12″ back from the mast, to hold the side stays; the bolts, if possible, passing through a frame.

correct length that the forestay can be fastened to the eye in the top of the bowsprit with a shackle, and the two side stays into turn buckles, the lower end of which are shackled into the chain plates. This allows the rigging to be set up taut. The bobstay is a piece of $\frac{3}{8}$″ galvanized wire rope, fitted with thimbles and turnbuckles to take up the slack.

The sails are made of heavy drill, the process being the same as described for the sailing dory. It is rec-

ommended, however, that two bights be turned in each cloth before sewing, as this makes a stronger sail, which is needed for the larger size. The appearance of the narrow bight is also good.

The outline is laid out on some large floor, if possible, using the diagonal measurement to obtain the angles correctly. The mainsail should be made about 9″ shorter on the hoist and gaff, and about 12″ shorter on the boom than the given dimensions, to allow for stretch. The procedure will be the same as for the smaller sails, but the labor will, of course, be much greater. The amount, however, will not be excessive if a good sewing machine can be used. The jib, also, must be made a few inches smaller. They must be strongly stitched with rather coarse thread and well reinforced at the corners.

Three rows of reef points are worked into the mainsail, 3′ apart, vertically. On a line 4′, 6′ and 9′ from and parallel to the boom, an eyelet is worked on each lap or bight; a piece of small cotton rope about 14″ long is passed through the eyelet half its length and held in place by a few stitches of thread, leaving one end on each side of the sail. These are brought down and tied under the bolt rope when it is desired to reef the sail. A strong thimble, or eye, is worked into each corner of the sail, and also one on the edges opposite each row of reef points. The hoist is divided into equal spaces of about a foot each and rather smaller eyes or grommets put in to fasten to the hoops. Eyes are also worked along the gaff about 8″ apart. These eyes may be sewed in over a ring, or the regular brass grommets may be purchased, which will save much labor. For fastening to the boom small thimbles are sewed along the foot about 9 inches apart. The jib has an eye in each corner and eyelets about 9″ apart on the edge, which goes on the stay. snap hooks should be fastened into these eyes so that the jib may be snapped on to the stay, and a larger snap hook at the lower corner hooks into the eye on the bowsprit.

In rigging the boat the mast is set up, the required number of hoops and the gooseneck band being first slipped on, and the rigging set up taught by means of the turnbuckles.

A mainsheet traveller of about ½″ galvanized iron is fastened across the stern to allow the main sheet to travel back and forth. A double deck block for the halliards should be fastened to the deck on each side of the mast, and cleats fastened on the top of the cabin trunk within easy reach from the standing room for fastening the halliards.

A cleat is fastened on the after end of the wash rail for the main sheet; other cleats and fittings may be put on as they appear to be needed. For blocks the ordinary galvanized iron blocks may be used. The main sheet is rigged as shown— the end looping over the boom end. The topping lift leads to a single block on the upper eye on the mast and down through the deck block. The throat halliard is rigged as shown, with two single blocks, the end leading down to a cleat. For the peak halliard one single and one double block are required, rigged as shown: the bridle on the gaff is of ⅛″ wire rope, eyes being spliced in to encircle the gaff, being prevented from slipping down by small chock pieces fastened to the sides of the gaff. The halliards and jib sheet are of 12-thread manila rope and the main sheet about ⅜″ in diameter.

In bending the sails the mainsail is first laced to the gaff with a small cotton cord or marline, a hole being bored in the ends of the gaff to allow it to reeve through. It is then laced to each mast hoop in turn and lastly, to the boom. For the latter purpose a cotton line is rove through the eyes on the boom and the thimbles on the foot of the mainsail alternately and made fast at the ends. The corners of the sail are held in place with marline. The sail must not be stretched very tightly at first or it will be ruined; it must be allowed to wrinkle slightly at first until some of the stretch is taken out.

The jib sheet blocks are fastened to a snap eye; one end is fastened to an eye in the deck, the other runs through a fair leader and aft to the cleat. Note that there are two jib sheets, one on each side. If it is desired to have the jib set more smoothly a boom about 5′ long may be laced to the foot.

After sailing the boat and becoming accustomed to her, various additions may be made to her outfit and rigging as may be suggested by experience. After the boat has been used half the season she should be hauled out and smoothed up and given a coat of paint and varnish. This care will amply repay the owner, as a new boat requires some attention while the several parts are setting into shape. All varnished wood should be kept well covered with varnish.

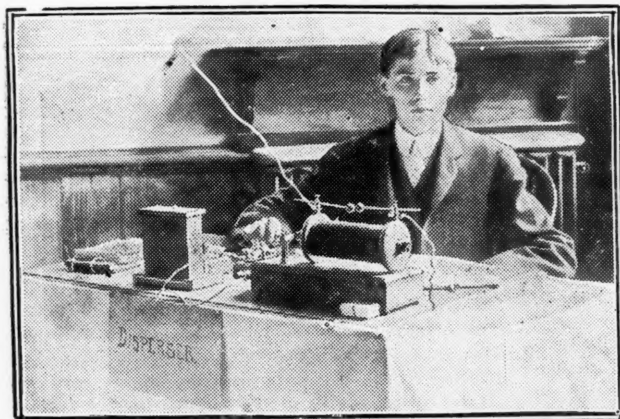
A writer in the Aluminum World gives the constituents of a hard alloy which has been found very useful for the operating levers of certain machines.

The metal now generally used for this purpose by the various typewriter companies is aluminum silver, or silver metal. The proportions are given as follows:—

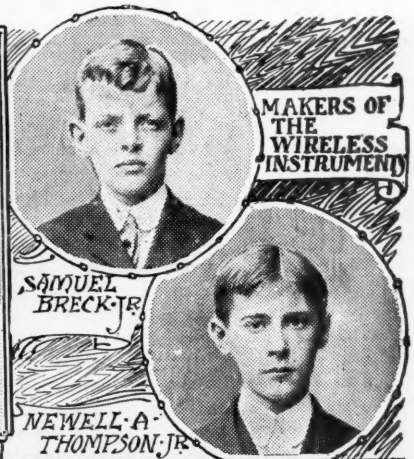
Copper	57.00
Nickel	20.00
Zinc	20.00
Aluminum	3.00

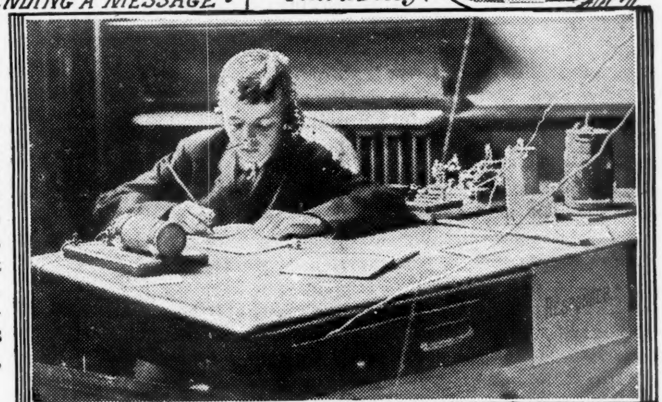
This alloy when used on typewriting machines is nickle plated, for the sake of the first appearance; but so far as corrosion is concerned, nickelling is unnecessary. In regard to its other qualities, they are of a character that recommends the alloy for many purposes. It is stiff and strong and cannot be bent to any extent without breaking, especially if the percentage of aluminum is increased to 3.5 per cent; it casts free from pin holes and blow holes. The liquid metal completely fills the mould, giving sharp, clean castings, true to pattern; its cost is not greater than brass; its color is silver white, and its hardness makes it susceptible of a high polish.

"WIRELESS" TELEGRAPH PLANT BY AMATEUR WORK READERS



NEWELL·A·THOMPSON·JR· SENDING A MESSAGE·





SAMUEL BRECK·JR· RECEIVING THE MESSAGE.

A wonderful piece of mechanism from the hands of schoolboys is that put on view recently in the Prince grammar school, Exeter and Newbury Sts. It is a wireless telegraph exhibit, and is the biggest surprise that has come to the management of Boston's schools during all the years that manual training has been a part of the system. The wireless plant is thoroughly equipped and is capable of being operated for eight miles. It is the work of Newall A. Thompson, Jr., 14 years old, of 553 Newbury st. west, and Samuel Breck, Jr., 13 years old, of 171 Bellevue st.,Roxbury, both of whom are in grade 8. The boy last tall visited one of the fairs in Mechanics' Building and became interested in a wireless telegraph exhibit there. Being readers of AMATEUR WORK, and seeing the various articles on "Wireless Telegraphy" appearing in the different numbers, they determined to make an outfit themselves. In young Thompson's workshop the boys labored, and on Patriot's Day they were able to operate successfully for a distance of 256 feet. The experiments were carried further, and already they have demonstrated its practical ability by sending messages across the Charles river, which is not far from young Thompson's home. It has been found upon test that eight miles can be readily covered. Besides receiving parental advice and encouragement, both boys have been given much help by E. Bentley Young, master of the Prince school, and by the instructor in manual training, John C. Brodhead. The first receiver which the boys made was worked out under Mr. Brodhead. The apparatus was set up on the platform in the hall of the school. Visitors were greatly interested in the receiving and sending of messages. With the exception of one or two pieces of apparatus quite beyond their powers of construction at present, the work was done entirely by the boys.

As a result of three years research, Prof. Burgess, of Wisconsin University, aided by an assistant, has, it is said, found a method of making pure iron at a cost of a cent a pound. The process is stated to be somewhat similar to that of refining copper electrically. Pure iron, on account of its electrical properties, is very valuable, and in great demand for the construction of electrical apparatus.

Paper stockings and gloves are now said to be in progress of manufacture. They are said to last as long as those made from more ordinary materials, which is not saying very much.

PHOTOGRAPHY.

THE "PYRO" DEVELOPER.

The professional, as well as the old stager in the amateur ranks, uses pyro. The novices uses one of the many newer developers. For years, writes F. J. Clute, in the St. Louis and Canadian Photographer, we have been told by the former that their reasons for giving pyro the preference was that it gave them more control. None of them have told us just why this "pliability" of the pyro developer was so universally observed by the older workers. They themselves have, in many cases, put forward the theory that it was no doubt owing to their familiarity with its working. Its poor keeping qualities and inclination to stain the hands has been the reason most generally given by the amateur for his discarding it in favor of one of the more cleanly working developers. The real reason why the pyro developer gives an amount of control not obtainable with any other reducing agent lies in the fact that pyro possesses, as distinctive from all the other developers, the quality of working softly like metol or rodinal, when well diluted, while still retaining the power of equalling hydroquinone or glycin as a producer of hard negatives when used in a less dilute solution. This good quality is possessed by none of the other reducers; at least, only to a very limited extent, and at once explains the preference of the experienced worker for "good old pyro." Prepared intelligently, its keeping qualities in solution are all that can be reasonably desired. Any developer will deteriorate, and where the deterioration is indicated by a relative amount of discoloration, this discoloration is more of an advantage than otherwise. The staining to which pyro pleads guilty is another bugbear that the tyro has been taught to dread. If the fear of staining his fingers would only keep him from continually raising the plate from the tray to hold it in front of the ruby glass, well and good. Use pyro and leave the plate to the mercy of the solution. Learn to judge the condition of the latent image, gradually becoming visible, by the time required and the way in which it comes up as the plate lies in the tray. It is this holding the partially developed negative with its glass side close to the lamp that causes many of the poor negatives that the tyro turns out. Leave the plate in the solution, where the film of amber colored developer serves the same purpose as an extra sheet of ruby glass, and you will obtain clearer negatives. Of course, as development nears completion, an examination by transmitted light is occasionally required. Rubbing a little vaseline well into the ends of the fingers, around the roots, and underneath the ends of the nails will prevent stains. Afterwards wiping the hands well on a dry cloth will leave the vaseline where stains are most liable to occur, while removing it from those parts of the fingers most likely to come in contact with the holders, slides, and plates. Use a two solution developer, of course. Boil the water used to dissolve the pyro to expel the air. Add a few small crystals of citric acid, that the solution may not be alkaline; use a good quality of sulphite, and keep well corked. For the alkali solution, less precautions are required. Use common washing soda, and filter the solution.

You can dry a negative very quickly within five minutes by taking advantage of the property of methylated spirit to displace the water within the pores of the gelatine. Once the water is removed the spirit volatilises quite readily in the air, leaving the negative dry within a few minutes; but to succeed with the method it is most necessary that the water should be thoroughly removed, and this will not be the case unless it is placed in a bath of strong spirit. If a number of negatives are being handled, the water extracted from each soon weakens the spirit, and that is why the following procedure should be adopted:—Take three batches of spirit, and place the negative in Nos. 1, 2, and 3 in turn each for five minutes, filling bath No. 1 with a fresh negative as soon as the first is in No. 2, and so, keeping the three dishes occupied. As soon as the negative comes from the third bath it will dry almost instantly on being waved in the air. Though not necessary, it is a good plan to mop off as much surface moisture as possible, before putting the negative in the spirit, with a soft cambric pocket handkerchief. In the course of time, all the spirit baths naturally become weakened by the absorption of water. Then they should be collected in a big bottle and dry potassium carbonate, in fair quantity, be added, and shaken occasionally. The water will be absorbed by the barbonate, and will collect at the bottom of the bottle as a heavy liquid. The renewed spirit can then be poured off.

Negatives are labelled by but few photographers with even a fair amount of success. And yet the work is easy, as the following, from the *Photographic News* will show. Dissolve some maroon aniline in powder, in methylated spirit, so as to make a very strong solution. In some places the solution can be bought ready made and is used for coloring dresses, etc. Add to it an equal bulk of water, and a little gum solution or glycerine, to keep it from running too quickly off the pen, and then write with this ink on the film, using a fine pen. It will give clear, sharp, and well defined letters. On glass negative it must be written the reverse way, and this is said to be easy after a little practice. With celluloid films coated with gelatine on the back, write on this back in the proper way.

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

ELEMENTARY MECHANICS.

J. A. COOLIDGE.

V. The Pulley.

The pulley is a wheel with a groove in its rim set in a frame or "sheaf". The wheel must turn freely upon its axis and carry a rope in the groove of its rim. If the frame of the pulley be stationary the name "fixed pulley" is given it, and its value consists in enabling a force to act in some other direction than the direction we wish the weight to move.

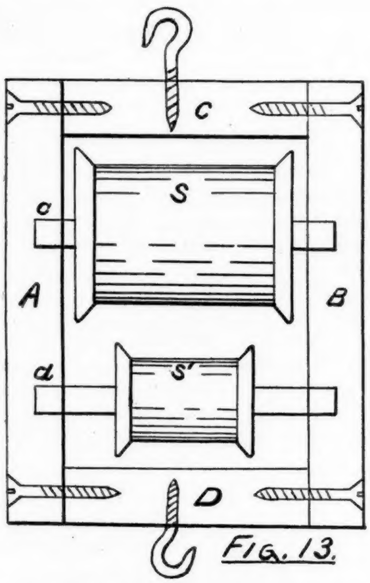


Fig. 13.

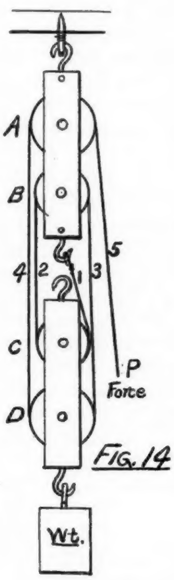


Fig. 14

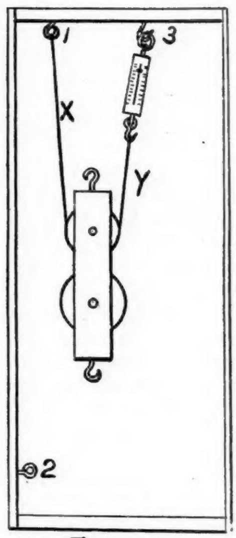


Fig. 15.

Who has not seen bales of hay lifted, one by one, into a stable door in the second story? A man stands on the ground and pulls down on a rope that passes over a pulley above the barn door. The force pulls down, the weight rises. Better still, sometimes the rope passes through a second pulley and a horse is attached to the end of the rope. As the horse moves in a horizontal direction, one part of the rope is going down, the other part with the hay is rising until it stops opposite the open door, and a man standing in the doorway swings the hay into the stable. The pulley of this kind is like a lever having equal arms. The force must be equal to the weight lifted and enough more to overcome the friction. The advantage of the fixed pulley is a change in direction of the force, or lies in the ability to use the force of animals.

If two or more wheels are set in the same frame they make, with the rope used, what is called a block and tackle. In a system of pulleys, one pulley must be fixed and another be movable. We will new make a pair of pulleys, each having two wheels, and learn from the experiments we may perform, the laws governing their use. and the advantages gained by using them. To one able and willing to buy some metal pulleys, directions for making them may be omitted. I have purposely made these of wood because, to most of the readers of these articles, I feel that the matter of expense is one of the foremost considerations, and with the materials needed for these pulleys the expense will be very slight.

Take a small piece of half-inch stock, cherry, maple, or other hard wood, preferred, cut two strips, *AB*, Fig. 13, 4'' long, ½'' wide, and two others, *CD*, 2¼''x½'' In each of the long strips bore two holes, c and *d* 5-16'' in diameter and ¼'' deep. Make c centre 1⅝ from the upper end, and *d* 1⅜'' from the lower end. Take two brass rods ¼'' diameter and 2¾'' long, on one place a spool *S*, 2'' long and 1¼'' smallest diameter; on the other place a smaller spool, *S'*, 1¼'' long and ¾'' in diameter. These may be fastened to the rods with glue, but should be made very smooth. The rods should be

fitted into the holes *c*, *d*, and should turn in these holes wilh very little friction. A little powdered graphite helps them turn readily. The frame may now be fastened at the corners by inch screws, or 1¼″ wire nails. A little glue in each joint will make the frame more substantial. At each end of the frame a screw hook should be inserted, as in Fig. 13.

Our pulleys are now ready for use. They differ from those in everyday use in not having the wheels side by side, but are quite like some that are sold for experimental purposes. Should any prefer wheels of the same size, two spools can be used of the same size as *S* by making *AB* 4¼ long and making *d* centre 1⅝″ from the lower end. A box 2½′ or 3′ long, without top and bottom will give us a cheap frame in which to use our pulleys.

Experiment IX.

With our spring balance, first weigh the palley. Take a short flexible linen cord, fasten one end to a screw eye in the upper part of the box and the other to the spring balance, as in Fig. 15. Notice that the reading in the balance indicates only one-half the weight of the pulley. Hang a 16-ounce weight on the hook below and read again. We find that one-half the entire weight is held by string *X*, the other half by string *Y*. This is the secret of the pulley. The weight lifted is supported by two or more strings, each one bearing its part.

Experiment X.

Fasten one upper pulley to screw eye No. 1 in the upper part of the box, and the other to screw eye No, 2 in the lower part. See Fig. 15. Hang a 16-ounce weight on one end of the string, pass the string over one wheel of the upper pulley and through the small wheel of the lower pulley. The weight of the lower pulley will rest on the large wheel. Use the spring balance to measure the horizontal force which, applied to the end of the cord, will lift the weight. Both pulleys are fixed and the force used is more than the weight lifted, because of the friction. The only gain is the change in direction. If some very large weight were to be lifted a horse could be used in such an arrangement.

Experiment XI.

Arrange the pulleys as in Fig. 14. One end of the cord is attached to the lower hook of the fixed pulley, and, after passing over all the wheels, ends at *P*, where the power is exerted. A 32-ounce weight is hung from the lower hook of the fixed pulley, and an 8-ounce weight at the end, *P*. The weight is balanced by one one-fourth as large, because the four cords, 1, 2, 3, 4, are each holding one-fourth, and cord 5 is pulling against cord 4. The ratio of gain is 1 : 4. In place of the weight, *P*, use a spring balance and pull until the weight rises. Read the balance carefully and then allow the weight to descend, using just enough force on the balance to make its motion regular. Read the balance again. The difference between these readings shows how much friction must be overcome. This is, of course, considerable, and yet the gain in such a contrivance is apparent. Try two other weights and record carefully the results. Let us get the principle firmly fixed in our minds that, after deducting the friction, the weight lifted divided by the number of strings attached to the movable pulley must equal the power.

Where is the loss? Every machine shows a loss as well as a gain. Repeat experiment XI, measuring the distance that the weight rises while the power is moving over a distance of one foot. We shall find it three inches. To move a weight one foot will require the powor to pass through a distance of four feet.

Experiment XII.

Fasten the string to the upper hook of the lower pulley, pass it through the grooves of the four wheels, and then fasten the end to our spring balance. Hang the upper pulley on screw eye No. 1, and the balance on screw eye No. 2. We now have five strings attached to the movable pulley. Hang weights amounting to 10 oz., 15 oz., 20 oz. and 25 oz., on the hook of the lower pulley. Compare the readings of the balance in these cases with the weights. Do they not run 2, 3, 4, 5, respectively? Other arrangements are possible and should be tried. Call to mind where you have seen pulleys used and the advantage gained by their use. Seldom a house moved but that the gain in power, increased as it is by using the crank and axle, is still further magnified by having the ropes pass through a system of pulleys. A pulley also plays an important part in derricks. In lifting large gas pipes and water pipes and lowering them into their trenches, pulleys are frequently used. Lastly, on board ship their uses are many. Single pulleys are so frequent that we need mention but a few. Windows open and shut easily because it is balanced by weights that hang on the opposite sides of two pulleys. The cages in elevators are balanced by weights hanging on a cable or cord that passes over a pulley. Tnese instances show us the value of pulleys and the many uses to which they may be put.

HOW BOYS CAN EARN MONEY.

III. Making Jardiniere Stands.

RALPH LAWRENCE BUGBEE.

One of the easiest ways for a boy with a capital of $5 to earn money is by making small jardiniere stands and selling them to neighbors and friends. These stands are made of whitewood, oak, or other suitable wood, are octagonal in shape and have four curved legs. They are about 18″ high, and are very pretty when carefully made and finished with light oak or ebony oil stain. The tools and materials should not cost more than $3.50. A saw, plane, half-inch chisel, half round file and sandpaper will be necessary, also stains, shellac, varnish and brushes.

The top is cut from ⅞″ stock, 12⅛″ wide, in the form of an octagon 14″ diameter; the upper edges should be bevelled at an angle of 45 deg. down to lines drawn ¼″ from the upper edges.

The four legs are made from ⅞″ stock and 12″ wide. A board 7′ long will make twelve legs of the shape shown in Fig. 2. They can be sawed out at home on a jig saw, but had better be sawed out by a band saw at some wood-working shop, if possible, where the stock is purchased. On two of the legs the space between *A* and *B* should be 5¼″, but on the other two, 5¾″.

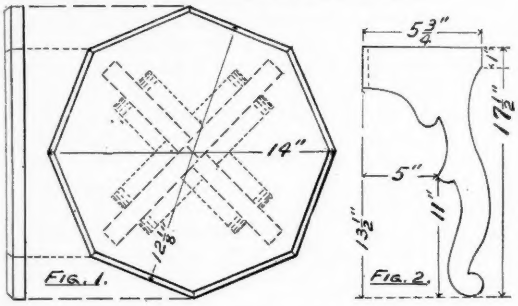


FIG. 1. FIG. 2.

After carefully smoothing the top with sandpaper, and the legs with a half round file and sandpaper, cut eight small blocks ⅞″ square, four of which should be 3″, and the other 3⅞″ long, the outer ends being cut to a half round.

To put the stand together, take the two legs, the tops of which measure 5¾″ and glue the two inner sides together; then take the other two legs and glue them on opposite sides of the joint, as in Fig. 1. The outer edges of the legs should come 1¼″ from the edges of the top. The short blocks are then glued to the legs and top, as shown in Fig. 1.

The way to stain and finish has been fully described by Mr. Putnam in the Nov., 1902, number of AMATEUR WORK, so is not given. The stands are sold at prices varying from 75 cents to $1.50, according to wood and finish.

VARNISH MAKING.

The resins used in making oleo-resinous varnish are of vegetable origin, and some are said to be collected from the trunks of living trees; but by far the most of them are found in the earth, the trees which produce them having died, fallen, and decayed, and the lumps of resin having become gradually buried in the soil; where they have remained for hundreds or, perhaps, thousands of years. In some cases, these lumps are found to contain insects, which were buried in them when they had the consistency of a soft balsam; and their antiquity is shown not only by hardening of the resin, but also by the fact that the insects, of which hundreds of sorts have been found, belong to species now extinct. These resins, which are found in tropical and sub-tropical regions, are collected by the natives and sold to the traders, who sort and clean them before shipment. The price of standard kinds have doubled in the last fifteen years, the supply failing to keep pace with the increasing demand.

The apparatus of the varnish-maker is simple. It consists of a cylindrical, flat-bottomed copper kettle, 3′ in diameter and 3′ deep, loosely mounted on a low, four-wheeled truck which may be drawn about by the workman. The kettle is provided with a loose cover in which holes are made to receive the stirring-rod and to facilitate the escape of gases. The stirring-rod is a slender steel rod with a wooden handle, about 5′ long. The thermometers used in regulating the temperature of the kettle's contents are about 3′ long, protected by well-made brass cases.

In the kettle the operator first puts the resin, 100 lb. being the standard charge, though 125 lb. is more frequently used. The kettle is then wheeled over a hot coke fire which is built in a fire-pit, under, or adjacent to, a chimney with a flue of from 10 to 25 sq. ft. cross section. This chimney creates a draught of great volume, necessary not so much to carry off the products of combustion, for very little fuel is used, as to remove the vapors generated in melting the resin, which are very acid and irritating, as well as highly inflammable. The kettle is kept over the fire about half an hour, or until the resin is all melted, which the varnish maker knows by feeling the liquid to be smooth as he stirs it, and by looking at drops of it which he withdraws on the stirring-rod. The temperature rises to about 600° or 700° F.

When all is melted, the kettle is drawn from the fire, the cover lifted off, and a quantity of hot linseed oil is gradually added. If it is desired to make a hard and brilliant varnish, the amount of oil may not be more than 8 gal. or 10 gal. to the 100 lb. of resin weighed before melting; but if it must have more elasticity, more oil is used, and for a varnish to be exposed to the weather, as on the outside of a carriage or a yacht, as much as 25 or 30 gallons is employed.

When the oil is all in, the kettle is put back on the fire and the mixture is cooked until its components have thoroughly united. If this operation is not sufficiently carried out, the resulting varnish will lack some of the durability that it should normally possess; if carried too far, the product will be too thick, and will require thinning with spirits of turpentine to an excessive degree, causing too thin a final film.

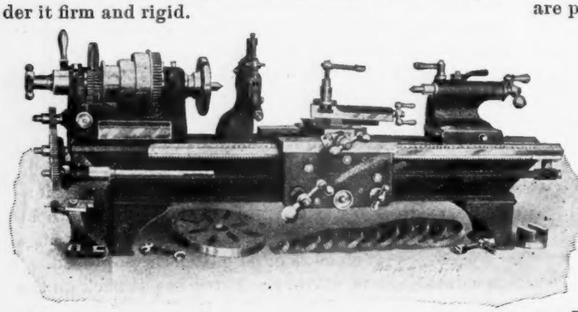
When properly cooked, the kettle is removed from the fire, and when it has cooled down to about 300° F. enough spirit of turpentine is added to make the varnish, when cold, of the proper consistency to flow out under the brush. The amount of cooking, the range of temperatures, and the quantity of turpentine needed are all empirically determined for each kind of varnish. It is then kept in tanks for several months, when it is found to be clear and ready for use.

Cassier's Magazine.

TRADE NOTES.

There seems to be a growing demand for an accurate and reliable bench lathe that can be bought at a moderate price and at the same time is a complele screw-cutting, engine, bench lathe, suitable for laboratory, electrical, optical and experimental work, tool, model, scientific instrument making, etc. ; in short, for profitable use in all lines of fine, accurate manufacturing and precision service. The " star Special " screw-cutting bench lathe, here illustrated, has been built to supply this demand. The manufacturers claim that much of the work that is now being done on large and expensive tools can more profitably be done on this lathe.

The head-stock has a large, hollow spindle, made from a crucible steel forging, with draw-in chuck for split—collete up to ½-inch capacity, phosphor-bronze boxes with improved end-thrust ball-bearings ; the cone pulley has three stops for wide belt, and with strong back gears gives six changes of speed; a push-pin on the head-gear allows the cone to be instantly locked or unlocked without using a wrench. The tail-stock is the curved or cut-under pattern, which allows the compound rest to swing around parallel with the ways and over base of tail-stock, with room to operate feed-screw handle; the spindle has an improved locking device and the tail-stock is provided with side adjusting screws for turning tapers, has a long bearing on the bed, and is locked in such a manner as to render it firm and rigid.



The carriage has long bearing on the ways, is gibbed to bed both front and rear. A cam locking device locks carriages to bed when using cross-feed. The cross-feed screw has a graduated collar which reads in thousandths of an inch and can be set at zero in any position. Plain and compound rests are regularly furnished and easily interchange. The base is graduated 180 degrees and renders the compound rest capable of fine adjustment. The tool-post has patented collar and shoe, which exclude all dirt and chips and admit of quick, easy and secure adjustment of the tool. If desired, can furnish the European tool-post in place of the regular American tool-post, without extra charge.

The automatic cross and longitudinal feeds are actuated by a phosphor-bronze worm on the lead-screw, receiving its power from the head spindle through spur gears, the lead-screw is splined and simply acts as a feed rod, therefore the only wear on the threads is in screw-cutting. The automatic feeds are almost indispensable for a large variety of work, as they secure more accurate and smoother surfaces. The range of feeds is very large. The range for screw-cutting is extra large, cutting all standard threads, right or left (including 11½″ and 27″) from 3 to 64 without compounding the gears and nearly all threads by compounding. When desired to cut both standard and metric threads there can be furnished, for a slight advance in price, transposing gears and index for cutting International Standard Metric threads from 0.5 mm to 8 mm. The lead-screw is cut from a master screw by a new process from 30 per cent carbon steel, making an accurate, durable and most desirable lead-screw. When desired to cut metric threads only, a metric lead-screw and index is furnished in place of the regular lead-screw and index at same price. Patented spring-nuts are used in connection with split washers to hold the change gears in place. They are easy and convenient to operate and allow quick shifts of the change gears.

The bed is 46″ long, broad, deep, thoroughly well braced and accurately proportioned throughout. The rated swing is 9″ but has an actual swing of 10⅛″ over bed, and 24″ between centres. The countershaft (patented) has friction clutch pulleys, easy to operate, strong and durable, also has self-alighning and self-oiling shaft bearings. The pulleys and friction bands are provided with self-closing oil cups.

Each lathe is furnished with large and small face plates, center rest, follower rest, two hardened and ground point centers, a full set of change gears and wrenches.

Extra attachments are: Taper attachment, milling and gear-cutting attachment, and blocking can be furnished when desired. While these lathes are designed for working metals, with the addition of a hand rest, screw-chuck, cup and spur centres, are suitable for wood turning.

The "Star Special" lathe is made by the Senaca Falls Manufacturing Co., 103 Water Street, Senaca Falls, N. Y., U. S. A., makers of the well known line of foot and power "Star" lathes. They will be pleased to send full description on request.

The 1904 catalogue of the S. W. Card Mfg. Co., Mansfield, Mass. presents in attractive form the various lines of taps and dies manufactured by this well known company. Those needing anything in this line should send for this catalogue.

Catalogue No. 11 of the H. H. Mayhew Co. Shelburne Falls, Mass. shows a full line of screw drivers, bit braces, glass cutters, drills gimlet bits, countersinks, nail sets, etc. Teachers of wood-working in manual training schools will find in it much of interest.